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Per the requirement of Section 1.16 on public records, IBM expects that our response to Section 3.7.B.5 will be kept confidential. This information should not be released because a formal announcement of this product has not yet occurred. It is IBM's policy to keep confidential marketing plans and roadmaps for new products.





400 Locust Street
Des Moines, IA 50309

December 18, 2000

Mr. Kenneth Paulsen, CPPB
Purchasing Agent IV
STATE OF IOWA
Department of General Services
Purchasing Division
Hoover State Office Building – A Level
Des Moines, IA 50319

Dear Mr. Paulsen:

Thank you for the opportunity to respond to the Storage Area Network bid number BD00100S023. IBM, along with our partners, VERITAS and MSI, is pleased to present an integrated solution of hardware, software and services to the Information Technology Department.

The purpose is to provide ITD with a high quality and cost effective storage consolidation for your Intel-based and Unix servers. We have the integration experience necessary to bring together the long term enterprise objective of connecting SAN to WAN and SAN to SAN including the remote copy of data to geographically dispersed sites.

IBM values the ongoing relationship established with the State of Iowa. We are confident that IBM's long history of working together with ITD on providing storage and other solutions will enable us to meet your requirements both now and into the future. We have also partnered with MSI on this bid to enable us to provide comprehensive SAN technical expertise in Des Moines.

IBM is the industry leader in storage. IBM offers complete SAN solutions based on the IBM SAN initiative. This initiative encompasses SAN optimized hardware, state of the art software and a full range of services. IBM can assist ITD in planning and ensure that you avoid costly mistakes.

Per the requirement of Section 1.16 on public records, IBM expects that our response to Section 3.7.B.5 will be kept confidential. This information should not be released because a formal announcement of this product has not yet occurred. It is IBM's policy to keep confidential marketing plans and roadmaps for new products.

Thank you for your consideration of this proposal. If you have questions, please contact me, IBM's authorized representative, at 515-283-4356. We look forward to working with you on this exciting and critical project.

Sincerely,

Dawn M. Connet
Senior Client Representative

D. EXECUTIVE SUMMARY

IBM is pleased to respond to the State of Iowa ITD Storage Area Network (SAN) RFP. Storage and storage management disciplines are growing in importance in many organization's computing environment. The implementation of a SAN will enable ITD to optimize and simplify its IT infrastructure and align it with strategic policy initiatives today and in the future. More specifically, the proposed IBM solution will provide ITD with the flexibility to share the same storage devices across all of your platforms. IBM's response to your RFP encompasses IBM hardware (sourced from IBM's business partner MSI), software from IBM and VERITAS, services from IBM and its business partner MSI, and IBM maintenance required to create a SAN infrastructure. Lastly, IBM's SAN solution is an "open", nonproprietary solution that supports IBM and non-IBM servers, storage devices, and software.

IBM Enterprise Storage Server Disk

At the heart of IBM's storage product line is the Enterprise Storage Server (ESS) which is a key component to implement an open SAN architecture. The ESS is IBM's premier disk storage device, which can be shared among multiple heterogeneous processors. Meeting the unpredictable demands for data in today's interconnected world of government, business and commerce requires much more than the capability to store terabytes of data. It requires data to be universally and immediately available all the time - regardless of the size of the network, the diversity of platforms, or the operating systems and connection types employed. With concurrent support for many platforms, advanced performance features, a snap-in design offering easy and quick upgrades, and scaleable capacity, the IBM Enterprise Storage Server is the most powerful and versatile disk storage solution available. The IBM Enterprise Storage Server supports today's most demanding applications and its design enables it to easily integrate into SAN infrastructures.

The IBM ESS offers many advantages over its competition. It is the highest performing disk subsystem available. The ESS performance advantage comes from its high performance HDDs (disk drives) attached via a serial storage architecture (SSA) interface. Not only are the drives the fastest in the industry, but every disk can be transferring data simultaneously on the SSA loops (unlike all other competitors where the SCSI or FCAL bus can only have one disk active at a time). This high degree of I/O parallelism provides the best performance in the "open" systems environments (UNIX and NT) where data storage characteristics are predominantly cache unfriendly and for cache misses in an MVS environment. For MVS work, the ESS has an "IBM exclusive" feature called Parallel Access Volumes (PAV)" which eliminates MVS IOSQ time. The PAV feature allows MVS to dispatch multiple I/Os to the same volumes without queuing. PAVs not only improve performance, but they also dramatically reduce wasted disk space caused by data set isolation, allow more disk space to be allocated, and significantly reduce customer staff time normally required to manage data set placement. At this time, IBM is the only vendor that offers SSA disks and PAVs.



D. EXECUTIVE SUMMARY

The IBM Enterprise Storage Server addresses one of the biggest contributors to total cost of ownership: the labor associated with managing storage-related issues. With the IBM StorWatch Enterprise Storage Server software family, IT professionals can easily and centrally manage configuration and capacity requirements online via a simple Web interface. The StorWatch Enterprise Storage Server Specialist and StorWatch Enterprise Storage Server Expert enable centralized control of multiple Enterprise Storage Servers - regardless of where they are located in an organization.

The IBM ESS is the most reliable disk system available. It has been designed with no single point of failure or repair. The ESS uses a dual cluster design. The dual cluster design provides load balancing and fail-over/fail-back operation. Component replacement, microcode loads, and most hardware upgrades can be performed concurrently with normal operations.

The IBM ESS provides industry leading advanced copy functions. FlashCopy is a point-in-time copy function. Almost instantly, an entire disk volume can be copied and accessed in a few short seconds. Many copies of the same source volume can be made in seconds. FlashCopy is controlled by the user and does not require IBM personnel for set up or changes. The IBM ESS also provides industry leading Remote Copy functions for short or long distance data mirroring. The Peer-to-peer Remote Copy (PPRC) function is a synchronous remote copy supported at distances up to 100km (longer distances are possible via RPO depending on workload). The eXtended Remote Copy (XRC) function is an asynchronous remote copy used for long distance data mirroring (i.e. 1000s of miles).

The IBM ESS is based on IBM's Seascope Storage Architecture. Seascope storage products use high performance RISC processors as storage servers, IBM disk and tape devices, and advanced storage management software to provide an integrated storage system for disk and tape data. As technology advances in these components, Seascope products can be field upgraded with the latest technology protecting the customer's investment like no other vendor. For example, the initial IBM ESS model E20 was field upgradeable to the new model F20 which provided over 100% performance improvement at an incremental upgrade cost.

IBM Storage Area Network SAN Hardware

IBM is responding with two SAN designs that can satisfy the 53 server Phase 1 requirements. The first uses a 16-port IBM 2109 switch as the basic fabric building block and requires a tiered fabric design to provide redundant paths between server and storage and insure high availability. The 2109 is built by Brocade Corp and is also known as the Silkworm 2800. The second design uses the IBM 2032, a 32-port director from McData as the building block. The director-based fabric utilizes both redundant paths and highly available hardware configurations to maximize connectivity, performance, and availability. Both the Brocade switch and McData director are industry leading, standards-base products. They are widely installed in many customers' SANs. While both these designs can support the Phase 1 requirements, there are a number of differences in the approaches to availability, scalability, management, performance, and price that would be reviewed during the Phase 1 assessment with the State of Iowa before a final design selection is made.



D. EXECUTIVE SUMMARY

IBM Storage Area Network SAN Software

SANs bring many benefits to IT organizations today, including the ability to extend distances, share infrastructure, and share storage resources like disk and tape. The true power of SANs can only be unleashed as this sharing is extended to file systems and data sharing, enabling organizations to share data across heterogeneous platforms, reducing multiple copies, enabling everyone to share the most recent information, and reducing the consumption of expensive resources due to wasted space and increased complexity. Tivoli SANergy enables many different operating systems to all share the same disk space, and even files. It uses the same security and file locking currently implemented on your LAN, so there are no new tools to learn. Often used as a superior alternative to Network Attached Storage, SANergy allows storage to be formatted in a single, standard file system, which can then be shared at very high SAN speeds by other file systems. NAS simplicity with SAN performance is the hallmark of this patented software that runs on over eight operating systems, any storage hardware, and is SNMP managed. SANergy delivers high performance, high availability, for streaming video/audio, data mining, graphics, and all large data environments. You will immediately notice a dramatic improvement in the speed of file loads and saves. Additional benefits include more efficient usage of storage and reduced administration of storage space. This shared storage can even coexist with other storage partitions in a centralized storage server. When installed on a tape backup server, SANergy enables server-free backup and restore of files directly between disk and tape. Easy to install and manage, SANergy is one of the most powerful tools to exploit the true power of your Storage Area Network.

For management of the SAN, IBM is proposing the Tivoli Storage Network Manager (TSNM). TSNM simplifies the complexity of managing information across the multiple platform and operating environments typical in a SAN, enabling customers to leverage best-of-breed technology to gain competitive advantage. SAN topology and disk resource discovery, continuous monitoring, and policy-based automation and expansion capabilities help customers insure availability of mission-critical applications thereby providing higher storage resource utilization for maximum benefit to the customer's storage investment. Tivoli Storage Network Manager is built upon a highly scalable architecture and ANSI T11 FC-MI discovery and management standards, making it easy to grow with the business to deploy and manage a small SAN or a very large, complex SAN infrastructure. TSNM provides disk management, file system policy management and event reporting, and can easily integrate into NetView.

For backup and restore of SAN data, IBM Global Services has partnered with VERITAS to provide their Netbackup product. Information about this product is contained in section 3.6.



D. EXECUTIVE SUMMARY

IBM Global Services

To help bring the solution together from a design, test, and build perspective is IBM's Global Services organization. IBM is the world's largest I/T Services Company with operations in over 160 countries. The IBM GS approach emphasizes collaboration, teamwork, and provides a structured framework built on a proven methodology, called the Information Technology Process Model. The benefit of using this approach is that it allows us to tailor each engagement to the specific needs of a client, while leveraging the intellectual capital, experience, and best practices of our global organization. The IBM Global Services team is in a unique position to have ready access to IBM's labs and advanced technologies. IBM's access to these resources will enable ITD to build an infrastructure that works well today and is positioned strategically to support ITD in the future. IBM has also partnered in this proposal with MSI, an IBM business partner. We are confident that IBM's and MSI's skilled services staff will provide excellent consulting/design/technical and maintenance service wherever ITD requires.

MSI Systems Integrators

MSI has offices throughout the Central Midwest, in Des Moines, Cedar Rapids, Moline, Council Bluffs, Omaha, Minneapolis, Milwaukee, St. Louis, Sioux Falls, and Kansas City. MSI currently has 250 employees, with the majority (70%) being technical personnel with numerous industry certifications. As ITD moves to support a statewide SAN implementation, IBM and MSI are uniquely positioned to ensure ITD's success. MSI architects, builds, and supports information technology solutions designed specifically for the business-critical requirements of its clients. MSI offers broad experience in enterprise SAN and storage solutions and has numerous specialists with expert SAN and storage skills. IBM chose MSI to be one of the first five SAN Solution Centers in the world. MSI has a state-of-the-art SAN lab located in Omaha, Nebraska, with IBM and non-IBM servers connected via fibre SAN to IBM enterprise disk and tape solutions. All of the hardware components we have proposed to you are installed in the MSI Omaha SAN Lab. IBM has also invested \$400M in a large scale SAN interoperability lab in Gaithersburg, Maryland, that contains IBM and non-IBM servers and storage solutions. IBM and MSI invite the State of Iowa to utilize either the MSI SAN lab or Gaithersburg IBM lab for demonstrations and hands-on experience with different SAN hardware and software solutions.

IBM SAN Initiative

Tying all of these elements together is IBM's overall Storage Area Network initiative. The IBM SAN initiative is an IBM corporate commitment to provide the complete range of software, hardware, services, infrastructure, and technology required for businesses to successfully implement a SAN. This initiative is supported at the highest levels of the IBM Corporation and is often a topic addressed by Lou Gerstner, Chairman of IBM, in his conversations with clients.



D. EXECUTIVE SUMMARY

As we look to the future, IBM's SAN technology will evolve in three phases:

- ♦ SAN-attached storage, leveraging the any-to-any connectivity of SAN technology.
- ♦ SAN optimized storage exploiting SAN characteristics and delivering early SAN solutions.
- ♦ SAN optimized systems leveraging the mature technology and delivering on the SAN promise of system-wide solutions.

Initially, IBM is focused on Fibre Channel connectivity and device-level management, providing businesses the basic building blocks to enable IT resource management and information sharing anytime, anywhere across storage networks. Later, value will be added to the Fibre Channel infrastructure through new storage connectivity solutions and comprehensive fabric management, helping organizations manage, track and more easily share the complex and ever increasing volume of data created by business applications and the Internet.

We believe one of the most important factors in the development of SANs will be the ability to connect platforms and storage devices through open standards. This means, through common software interfaces, IBM is delivering tools to build platform-independent networks using open frameworks at all levels of network management. To that end, IBM actively participates in several standards boards. By providing a non-proprietary SAN fabric, ITD will be able to exploit new technologies through the delivery of end-to-end, managed SAN solutions.

IBM – The Best Partner for the State of Iowa ITD

IBM is ideally positioned to meet ITD's Enterprise Storage Requirements both now and in the future. IBM stands alone among storage providers in our experience with the full spectrum of storage technology. IBM Global Services has a full portfolio of services to facilitate a smooth implementation of SAN technology at ITD. IBM's global support organization is one of the key reasons why we believe IBM is the best partner for ITD.

Marrying storage, servers, and network disciplines, SAN technology requires an unprecedented level of cross-disciplinary expertise. No one else in the industry is as capable, as experienced, and as committed to providing multi-platform connectivity and integrated management of SAN networks. IBM has demonstrated its ability to execute. IBM provides comprehensive storage solutions that integrate rich software, enterprise storage management, and a full range of disk, tape, and optical storage technology spanning the range of servers from Windows NT, Unix, and midrange to S/390.

IBM knows IT. No other company in the industry is as capable, as experienced, as committed to providing multi-platform connectivity and integrated management of Storage Area Networks. In partnership with IBM, ITD is best positioned for the successful implementation of an open, scaleable, centrally managed enterprise storage environment.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

1.0 Administrative

IBM understands the contents of Chapter 1-Administrative Issues. IBM and the State of Iowa are already bound by an existing IBM Customer Agreement (ICA). We are compliant with the terms in Chapter 1 and 2 except where superceded by the terms of the existing ICA. IBM and the State of Iowa have invested significant effort in establishing this Master Contract and we propose using the agreed upon contract language as the contractual basis for this work.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

2.0 Contractual

IBM has reviewed Chapter 2, Contractual Terms and Conditions for this RFP and understands the objectives in establishing a contract for SAN related hardware, software and services.

IBM's response to your RFP is made with the understanding that the terms and conditions of the IBM Customer Agreement (or any equivalent agreement signed by both of us), along with its applicable Attachments and Transaction Documents which are in place between us, will govern any ensuing transaction. These terms have served as the basis for many successful transactions between us and provide the basis for the attractive pricing we are offering.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.0 Mandatory Requirements

IBM is pleased to respond positively to all requirements of Chapter 3 for this SAN bid. Our proposal includes the following software all running on WindowsNT or Windows2000: VERITAS Netbackup and Shared Storage Option (SSO), Tivoli Storage Network Manager, Tivoli SANergy. We also offer the State options for switches (Brocade and McData) as well as other SAN offerings. The State of Iowa is attempting to build a first class environment for Storage Management which means that some of the functionality is still relatively new. We offer an integrated approach where we will bring together the best solution from multiple vendors to meet your needs.

3.1.A

The contractor shall provide a brief (no more than five pages) Process Model which explains their proposed storage network architecture and design development process and why they believe their approach best supports the requirements of the Request For Proposal.

When choosing a partner to assist in implementing an Enterprise-wide Storage Area Network, it is important to understand that partner's commitment and capabilities to provide a complete solution. Here is the strategy that IBM began implementing in 2000 to deliver SAN-enabled server and storage products, connectivity products, management and exploitation applications, and design and implementation services.

IBM Enterprise SAN Strategy.

Enterprise SAN is evolving. Businesses need to be able to grow quickly and without disruption. IBM can help you protect your current IT investments, while offering ways to exploit new features and technologies as they become available.

We recommend a strategy that involves migrating to an Enterprise SAN infrastructure over time. We intend to deliver our Enterprise SAN strategy in phases, to leverage new technologies as they mature, and to help businesses seamlessly integrate Enterprise SAN technology into their IT infrastructure, while protecting investments in storage, server and application resources.

IBM Enterprise SAN technology will evolve in three phases:

1. Enterprise SAN-attached storage, leveraging the any-to-any connectivity of Enterprise SAN technology.
2. Enterprise SAN optimized storage exploiting Enterprise SAN characteristics and delivering early Enterprise SAN solutions.
3. Enterprise SAN optimized systems leveraging the mature technology and delivering on the Enterprise SAN promise of system-wide solutions.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

Initially, we will focus on Fibre Channel connectivity and device-level management, providing businesses the basic building blocks to enable IT resource management and information sharing anytime, anywhere across storage networks. Next, value will be added to the Fibre Channel infrastructure by new storage connectivity solutions and comprehensive fabric management, helping organizations manage, track and more easily share the complex and ever increasing volume of data created by business applications and the Internet.

The IBM Enterprise SAN initiative is based on four key promises:

1. **Connectivity:** We will complement storage/storage-management, server, network, and software product lines with a full set of Enterprise SAN-enabled products to best fill your needs, from fabric components like gateways, hubs and switches, to native Fibre Channel attached disk and tape storage devices. Because you can't afford to implement a complete replacement strategy, investment protection and seamless migration paths are essential.
2. **Management:** The foundation of our Enterprise SAN strategy is a closed loop, "zero latency", "one touch" management infrastructure that accommodates both the traditional server-centric as well as the new storage-centric models and supports both IBM and non-IBM products.
3. **Exploitation:** The true value of Enterprise SAN is not the technology itself, but rather the business benefits that it provides. In its role as solution provider, IBM will exploit Enterprise SAN technology to deliver a set of business solutions – tape and disk pooling, copy services, and high availability clustering -- that address your most pressing IT challenges.
4. **Service and Support:** The Enterprise SAN promise of any-to-any connectivity and the complexity it introduces highlight the critical nature of both systems integration and services in any Enterprise SAN strategy. The industry's leadership service provider, IBM Global Services, in combination with service provider partners, will offer the services and education required to plan and support end-to-end Enterprise SAN solutions.

To support those promises we are committed to:

- ◆ Deliver tools to build platform-independent networks using open frameworks at all levels of network management.
- ◆ Exploit new technologies to provide customer value and benefit through the delivery of end-to-end, managed Enterprise SAN solutions.
- ◆ Transition mature, proven system management technology like IBM System Managed Storage (SMS) and utilize first-generation Enterprise SAN switched fabric management (ESCON) experience in building management tools for Fibre Channel networks.
- ◆ Support phased implementation to leverage current investments, avoid risk and minimize operational disruption.
- ◆ Provide 'best fit' choices via a flexible, scaleable building block infrastructure for plug 'n play interoperability, open standards compliance, participation in industry organizations like SNIA and FCA and multi-vendor/multi-platform partnerships.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

- ◆ Package solutions with comprehensive service offerings from early planning and design through integration, interoperability testing and certification.
- ◆ Put our experience to work for you

We have the experience and expertise to develop and implement the best practices required by the new generation of Enterprise SAN technology. Enterprise SAN is a long-term investment that demands stable, reliable partnerships. IBM has a history of technical leadership, delivering high quality solutions to address customer business problems.

Enterprise SAN provides the infrastructure necessary to support the on-demand scalability of today's e-business activities. We have decades of technology leadership and experience in enterprise computing across all platforms, making us uniquely positioned to define and implement the new Enterprise SAN infrastructure.

No one has more experience than IBM in aligning storage/information policies and practices, and providing business centric management of information through its entire life cycle - generation, storage protection, management, deployment and exploitation.

IBM SAN Services

The IBM Global Services Storage Practice is uniquely qualified to provide the full spectrum of IT assessment, design and implementation services. Our focus has always been on delivering solutions that answer our customers' needs.

We understand that it is not enough to be big, fast, single-source, reliable or dedicated. A competitive spirit - a desire to step forward, define and lead an industry, and give customers compelling reasons to work with such organizations above others guides successful enterprises. IBM Global Services is 125,000 strong in 164 countries - committed to ensuring and enhancing customer success. Naturally, skills go hand-in-hand with experience. IBM Global Services has consultants who have the specific knowledge to provide technology solutions from the smallest to the most complex project. And with virtual end-to-end coverage, we are willing to work with customers through any business stage - from strategy and planning, to design and implementation, to operations and maintenance. It is important to us that customers see IBM Global Services as a team of people they can trust - a resource of committed professionals to help them at each step with demonstrated results.

Highlights of some of our strengths at IBM Global Services:

- ◆ World's largest IT services provider
- ◆ 175,000 total contracts worldwide
- ◆ 750,000 non-IBM machines under contract
- ◆ Major worldwide consulting firm
- ◆ Total e-business capabilities



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

The Storage Services Practice of IBM Global Services is in the business of assisting clients like State of Iowa with storage system challenges. The IBM approach emphasizes collaboration, teamwork, and provides a structured framework built on a proven methodology, called the Information Technology Process Model. The benefit of using this approach is that it allows us to tailor each engagement to the specific needs of a client, while leveraging the intellectual capital, experience, and best practices of our global organization.

IBM has a broad portfolio of standards-based, open storage networking and storage management products. IBM Global Services has vast experience providing consulting, design, and implementation storage services in complex and multi-vendor environments. These capabilities make IBM a strong partner when building Enterprise Storage Area Networks.

3.1.B.1

The contractor must provide basic corporate and sub-contractor information to include, but not be limited to, ownership, size, and relationship with larger owner, financial resources, date of incorporation, and staffing locations.

IBM is the prime vendor responding to all the requirements of this request for proposal. We are proposing to use both VERITAS and MSI as subcontractors. International Business Machines Corporation (IBM) is a worldwide organization with corporate headquarters located at 1 Old Orchard Road, Armonk, New York 10504. IBM was organized to do business in Endicott, New York on June 14, 1911 and is incorporated in the State of New York.

IBM is in the business of helping customers solve problems through the use of advanced information technologies. The company operates primarily in the single industry segment that creates value by offering services, software, systems, products, and technologies.

IBM is the world's largest information technology company, offering hardware, software, and consulting services to clients around the globe. IBM has more than 269,000 employees with 126,000 people providing consulting, systems integration, and solution development services in more than 160 countries. Our investments in technology and services are unparalleled and we offer our customers a significant wealth of capabilities and experience. Our revenues were \$87.5B in 1999. IBM has staff in all major cities throughout the country and offices in Des Moines, Cedar Rapids, Davenport and Omaha, Nebraska. Our service engineers are located throughout the State.

MSI Systems Integrators is a technology leader who architects, builds, and supports comprehensive information technology solutions designed specifically for the business-critical requirements of our clients. MSI currently has 250 employees, with the majority (70%) being technical who have numerous industry certifications. MSI has offices throughout the central Midwest in Des Moines, Cedar Rapids, Moline, Council Bluffs, Omaha, Minneapolis, Milwaukee, Saint Louis, Sioux Falls, and Kansas City. MSI was incorporated in 1994. MSI revenue for 1999 was over 134 million.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

VERITAS Software has a global presence with more than 4,300 employees residing in 25 countries worldwide. With Pro Forma revenue for 1999 just over \$700 million, VERITAS Software was added to the Nasdaq-100 Index in January 1999 and the S&P 500 Index in March 2000. The Company's corporate headquarters is located at 1600 Plymouth Street, Mountain View, CA 94043.

3.1.B.2

The contractor must describe what methodology; development tools, standards and/or procedures will be used in each phase of the Project.

Phase 1 - Mainframe Shark Config Services

This service will include planning and configuration of up to a 1.6TB ESS for up to four hosts systems with identical Operating Systems with up to 10 volumes per host system to be configured within the ESS. All systems must attach to the ESS via Fibre Channel. Tasks to be performed will include the following.

1. Planning

An IBM Storage Specialist will meet with the customer to help plan their initial configuration or configuration change requirements. During this session the specialist will complete a configuration worksheet, and identify any host server change requirements. The worksheet will be used as input to the Configuration Task, below.

2. Configuration

Using the completed configuration worksheet, the IBM Storage Specialist will perform the following tasks:

- ◆ Configure the logical volumes on one Enterprise Storage Server using the StorWatch ESS Specialist a 'DASD configuration' tool supplied with ESS.
- ◆ Assign logical volumes to the designated host servers.
- ◆ Verify the logical volume definition and assignments against the configuration worksheets.
- ◆ Document the new configuration in a spreadsheet or the Visio chart tool and provide these to the customer.

Deliverable(s):

- ◆ Spreadsheet or Visio chart of the customer's ESS configuration



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3. Server Preparation

Install, on up to 4 ESS attached host servers, device drivers required to access the Enterprise Storage Server through the SCSI adapters.

4. ESS Customer Training

An IBM Storage Specialist will conduct a training session for up to six customer representatives at the customer location and using the customer's Enterprise Storage Server. The training session will consist of discussions/presentations on topics related to the function/features of the ESS and the use of the StorWatch Specialist.

The training can consist of the following topics:

- ◆ This is your ESS - Function and Features
- ◆ Configuring your ESS using the StorWatch Specialist
- ◆ Monitoring the performance of your ESS using the StorWatch Specialist

Deliverable(s):

- ◆ Up to six copies of the customer training documentation will be provided during the training session

5. Post Configuration Support

This task consists of support to be used following the completion of the on-site implementation activities. This time can be used for questions or assistance in further refining the configuration of the ESS or to discuss future change requirements.

SAN Design Services

Our proposal includes consulting services to develop, with your team, a Storage Area Network design for your environment. Tasks to be performed as part of this service include:

1. Review our understanding of State of Iowa inventory, and current environment based on the information we will be provided by State of Iowa
2. Assist State of Iowa in architecting a SAN fabric solution for their disk and tape environment that will:
 - a) Facilitate data movement between servers and storage devices
 - b) Allow for storage management and disk services from a single point
 - c) Allow for scalable capacity to be added without interruption to the SAN fabric
 - d) Provide high availability
 - e) Provide redundancy with no single point of failure
3. Assist State of Iowa in reviewing the overall backup/ restore strategy for a SAN environment



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

4. Assist State of Iowa in designing a plan for roll out of the new technology in a SAN storage environment using existing and new technologies
 - a) Define the tactical and operational plans for different aspects of storage operations, including:
 - b) Reliability management
 - c) Network availability management
 - d) Fault detection and recovery planning, covering hardware, firmware and software
 - e) Failure isolation and failure modes management
 - f) Dynamic reallocation of network resources
 - g) Data migration
5. Design storage, data and network solution that supports business goals
 - a) Create SAN Logical and Physical Design
 - b) Design and document the planned logical equipment and the physical environment
 - c) Diagram the configuration depicting the host, peripheral unit, power, cabling
 - d) Develop objectives, time frame, resources, measurements and reporting for implementation

Deliverables: SAN Design Report (Type II)

Proof Of Concept (Pilot SAN Implementation)

1. Shark configuration services as described in this section are equivalent in description to the shark implementation services required for the **MAINFRAME SHARK CONFIG SERVICES**.
2. SAN Fabric implementation (MCDATA switch configuration)

This service will include planning and configuration of the McData ED5000 devices (SAN Fabric). An IBM Storage Engineer will act as the IBM Project Manager of the entire SAN Fabric implementation and configuration. Tasks to be performed as part of this service include:

- ♦ Assemble project team (consists of both IBM and Customer personnel)
- ♦ Conduct SAN Fabric planning meeting
- ♦ Document hosts systems that require SAN Fabric attachment (up to 10 client hosts of the same OS type)
- ♦ Create project task list and schedule
- ♦ Conduct SAN Fabric Systems Assurance
- ♦ Inventory the delivered SAN Fabric and verify all components and options were received
- ♦ Advise Customer of cabling requirements and verify proper installation of all Fibre Channel cables between host locations and SAN Fabric location
- ♦ Configure EFC-Manager for Network and Dial communication services



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

- ◆ Configure EFC-Manager administrative accounts
- ◆ Configure SAN Fabric zone sets
- ◆ Configure SAN Fabric Alias host names
- ◆ Assist Customer with configuration of host systems for SAN Fabric communications
- ◆ Perform basis read/write tests between host and storage servers
- ◆ Perform informal SAN Fabric skills transfer with Customer personnel
- ◆ Provide system connection diagrams and host port assignment map to Customer for on-going maintenance

Deliverables (written documents, training materials, etc.)

- ◆ SAN Fabric host systems connection diagram
- ◆ SAN Fabric planning documents
- ◆ Functioning SAN Fabric based on McData ED5000 devices (successful read/write test)
- ◆ Functioning McData EFC-Manager workstation

Completion Criteria: The project will be considered complete once the deliverables have been provided to the Customer.

3. Installation Services for Tivoli Storage Network Manager

Tasks to be performed as part of this service include:

- ◆ Requirements assessment
- ◆ Tivoli Kernel Services and Tivoli Storage Network Manager Installation
- ◆ Installation of services and agents

Please note that Tivoli Storage Network Manager is a new product and further analysis will need to be completed before a promise of completion can be assessed.

Phase 2

Implementation of the Capitol Complex SAN is dependent on the completion of the SAN Assessment and Design effort proposed in this section. Implementation service methodologies relative to a Capitol Complex SAN are described in this section.

Phase 3

The completion of the SAN Implementation is dependent on the final SAN design selected by the State of Iowa during the SAN Assessment and Design phase. The SAN Assessment and Design services and implementation services are described in this section.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

Phase 4

Storage Area Network Mainframe Storage Integration

The objective of this task is to assist you in performing the tasks necessary to integrate the mainframe Shark storage into the SAN. We will help you insure that the hardware and the software in the SAN are configured and connected as specified in the planning session.

In this step, we will:

1. Perform a systems assurance review of the fiber optic cabling system components to insure they will meet the connection needs of the equipment included in the SAN.
(**Note:** Our review of the cabling system will not result in a warranty provided by us for the performance of the cabling system as a part of this SOW);
2. Assist you in installing the correct software driver on each server listed in the Schedule (up to 12 common OS servers)

3.1.B.3

The contractor must have successfully designed, implemented and administered projects of similar scope and size. Contractor proposals must include a minimum of three (3) references; include project name/description, location, contact person with phone number, and an indication of your level/degree of responsibility and accountability.

Enterprise Storage Server (ESS) References

McLeod USA

Installed 2 Sharks for S/390, AIX, NT, SUN
Attn: Neil Jones, 319-790-6799
6400 C Street SW
PO Box 3177
Cedar Rapids, IA 52406

Pioneer Hi-Bred

Installed 2 Sharks for "open" systems servers (AIX, SUN)
Attn: Bob Anderson, 270-4243
7200 NW 62nd Ave.
Johnston, IA 50131

Iowa Foundation for Medical Care

Installed 1 Shark with both MVS and Novell servers sharing capacity
Attn: John Burnley, 223-2176
6000 Westown Pkwy
West Des Moines, IA 50266



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Wells' Dairy Information Services

Installed IBM 2105-F20 Shark with 2 McData Directors for NT servers
Attn: Dan Hatting, 712-548-2933
126 3rd St. SW
Le Mars, IA 51031

Mutual of Omaha

Installed 2 IBM 2105-F20 Sharks with 3 McData Directors for IBM AIX, SUN, and NT servers.
Attn: Wayne Goodman, 402-351-3404
Mutual of Omaha Plaza
Omaha, NE 68175

Utilicorp United

Installed IBM 2105-F20 Shark with IBM 2109 (Brocade) switches for IBM AIX servers
Attn: Scott Martin, 402-221-2268
1815 Capitol Avenue
Omaha, NE 68102

Omaha Public Power District

Installed IBM 2105-F20 with IBM 2109 (Brocade) switches for HP-UX servers
Attn: Bruce Schenck, 402-636-2377
Omaha, NE

Mass Mutual

IGS conducted an enterprise wide storage assessment for the purpose of developing a long term storage strategy. IGS delivered a corporate wide SAN design (multiple designs for each implementation phase) for two company campuses that involved many phases with sub options dependent on hardware recommendations and capabilities. In addition, IGS researched and delivered reports covering interoperability issues, SAN management tools, and long distance connectivity solutions. The environment consisted of 135 NT servers, 40 Unix servers (mix of HP, SUN and AIX), multiple switches and storage units proposed, two sites on one campus and two campuses, a long distance remote requirement, and multiple EMC units installed.

The following references are for VERITAS NetBackup:

AOL

AOL was experiencing challenges with staying ahead of increasing online traffic and managing a heterogeneous environment. Addressing additional IT pressures included thousands of servers (Sun, HP and SGI) with multi-terabytes of data. These were broken up into three key operational groups: AOL hosting companies' home pages, Backup/Recovery and in-house custom databases.



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Our solution included NetBackup, Foundation Suite and agents. Immediate benefits were realized including 7 x 24 backup and recovery in a heterogeneous environment and shorter backup windows due to less server downtime and significantly lower administrative costs

Nortel Networks

Greater accessibility to Oracle Financials and the ability to ensure availability of Oracle DBMS Data where top priority in this datacenter. Their enterprise included 8000 Servers, 8,000 Desktops and 45 Terabytes of Data. VERITAS Software's solution included Event Manager, NetBackup Data Center and VERITAS Volume Manager. Nortel noticed improved data availability and 6-1 savings in operational labor costs.

Daimler Chrysler

Daimler Chrysler required the need to reduce time to market for new CAD designs. Their environment included 3200 Managed Nodes and 15 Terabytes of Data. Archiving of data through VERITAS Storage Migrator and data protection using NetBackup Data Center helped them improve their design to manufacturing cycle.

In addition, VERITAS NetBackup is in use by many government customers, including customers in the states of Oregon, Texas, Arizona, and Colorado. VERITAS would be happy to provide contact information.

3.1.B.4

Project Principals information

- a. The contractor's proposed Project Principals shall be identified in the proposal.*
- b. The Contractor's Project Managers/Leaders/Team must be identified in the proposal.*
- c. The contractor's Project Principals and Project Team shall not be substituted without prior approval of the State of Iowa's, Chief Information Officer.*
- d. Staff assigned by the Contractor shall possess cumulative experience with projects of similar scope and size.*

For this effort, the IBM Storage Area Network (SAN) Consulting Services provides a Services Architect(s) who will spend time at the State of Iowa conducting interviews and doing data collection. The team will then spend time analyzing the information and compiling the final report with the State of Iowa's input and validation. IBM will return to the State of Iowa and present our results in an up to a day meeting.



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We will designate a Services specialist who will be our focal point for all communications relative to this project, referred to as the IBM Project Manager. IBM will assist the State of Iowa in their SAN Design by providing a lead Project Manager who will perform the following tasks:

1. Maintain project communications through the State of Iowa Project Manager.
2. Establish documentation and procedural standards for the development of the project.
3. Resolve deviations from the SOW that may be caused by IBM.
4. Review and administer the Project Change Control Procedure with the State of Iowa Project.
5. Manager Coordinate and manage the technical activities of IBM project personnel.

For this effort, the IBM Storage Area Network (SAN) Consulting Services team has access to two highly experienced, certified specialists. Their resumes are included in Appendix E. The resources provided may not be available at the determined contract start date. If they are not available, resources with equal or greater capabilities and experience will be substituted.

3.1.C

1. Contractor proposals must include a detailed Work Plan explaining how the contractor intends to complete and obtain acceptance of their proposed solution to the requirements of each Phase of this RFP. At a minimum the Work Plan shall, for each Phase, include a statement of understanding, responsibility matrix (State and contractor), tasks with milestones and objectives (State and contractor) to provide the services and deliverables for each of the following Phases:

3.1.C.1.a.1

a. Phase 1 Information Technology Department (ITD). The following tasks are required:

1. Inside delivery, installation and full operation (production) of one (1) terabyte of mainframe storage not later than February 12, 2001. The Contractor shall provide all hardware, equipment, software and all transportation plus human resources required for delivery, unloading, installation and removal of packaging/crating materials. ITD shall not be liable for any charges for transportation and unloading including, but not limited to drayage, packing, cartage, boxing, insurance of any type, crating, handling or storage.

An IBM 2105-F20 Enterprise Storage Server (ESS), with 1260GB useable disk capacity, will be delivered, installed, and in full operation (production) no later than February 12, 2001. Provided will be all hardware, equipment, software, and all transportation plus human resources required for delivery, unloading, installation, and removal of packaging/crating materials.



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The configuration to be provided to ITD will include the following:

2105-F20 ENTERPRISE STORAGE SERVER	1	
♦ 1802 S/390 PAV UP TO 2 TB	1	
♦ 2123 DISK EIGHT PACK 36.4 GB	6	
♦ 2715 REMOTE SUPPORT FACILITY	1	
♦ 3011 ESCON HOST ADAPTER	4	2 ESCON ports per adapter
♦ 4002 8 GB CACHE	1	
♦ 9301 MODEM COUNTRY GROUP M01	1	
♦ 9401 CONVENIENCE CORD C01	1	
♦ 9647 1,260 GB CAPACITY	1	
♦ 9854 THREE PHASE 50/60 HZ 60 AMP	1	
♦ 9870 NOMINAL AC VOLTAGE 200V-240V	1	

3.1.C.1.a.2

2. Provide storage consolidation and implementation of a SAN for the ITD. The following tasks are required:

a. Not later than March 12, 2001 the Contractor shall develop, submit, and have accepted a formal document of the proposed storage network (SAN) architecture and design to include an assessment, available architectural and design options and recommendations to implement a State of Iowa Enterprise SAN solution.

b. Proof of Concept: Not later than June 1, 2001 the Contractor shall fully implement the accepted SAN architecture and design (from above) and consolidate storage for the specified servers (Attachment 3A). The Contractor shall submit a Business Case that completely describes the Proof of Concept installation and the business and technical benefits that will be realized when Phase 1 is fully implemented.

c. Following a successful proof of concept (item b above) the Contractor shall:

1. Not later than June 1, 2001 submit and have accepted a project schedule to complete the implementation of the SAN and storage consolidation of the remaining ITD servers (Attachment 3B is current as of this mailing).

2. Complete, in compliance with the accepted project schedule immediately above, the implementation of the SAN and storage consolidation of the remaining ITD servers (Attachment 3B is current as of this mailing).

Please reference Section 3.1.B.2.



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3.1.C.1.b

Phase 2 Capitol Complex: Continue storage consolidation and implementation of the SAN for the Capitol Complex. The following tasks are required:

1. Not later than June 1, 2001, the Contractor shall submit, and have accepted:

a. A formal document fully describing the proposed design and justifying any/all deviations from the approved SAN architecture and design (from Phase 1) including available options and recommendations.

b. A project schedule to continue implementation of the SAN and consolidate storage of Capitol Complex servers.

2. In compliance with the accepted project schedule immediately above, consolidate storage for a specified number of site(s) and implement the selected SAN architecture (Phase 2 proof of concept). The contractor shall submit a Business Case that completely describes the Proof of Concept installation and the business and technical benefits that will be realized when Phase 2 is fully implemented.

3. Following a successful proof of concept (item 2 above) and in compliance with the accepted project schedule, consolidate storage and continue the implementation of the SAN of the remaining Capitol Complex servers.

Please reference Section 3.1.B.2.

3.1.C.1.c



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Phase 3 Enterprise and Remote: Continue storage consolidation and implementation of the SAN for the Enterprise. The following tasks are required:

1. The Contractor shall submit, and have accepted:

a. A formal document fully describing the proposed design and justifying any/all deviations from the approved SAN architecture and design (Phases 1 and 2) to include available options and recommendations.

b. A project schedule to continue implementation of the SAN and consolidate storage of Enterprise and Remote servers.

2. In compliance with the accepted project schedule immediately above, consolidate storage for the State's three (3) major data centers and implement the selected SAN architecture (Phase 3 proof of concept). The contractor shall submit a Business Case that completely describes the Proof of Concept installation and the business and technical benefits that will be realized when Phase 3 is fully implemented.

3. Following a successful proof of concept (item 2 above) and in compliance with the accepted project schedule, consolidate storage and continue the implementation of the SAN of the remaining Enterprise and Remote servers.

Addendum Clarification:

Phase 1 addresses only the servers operated ITD. There are numerous servers throughout Iowa government and across the state.

Please reference Section 3.1.B.2.

3.1.C.1.d

Phase 4 Mainframe Storage: Integrate mainframe storage into the installed SAN environment. The following tasks are required:

1. The Contractor shall submit, and have accepted:

a. A formal document fully describing the proposed design and justifying any/all deviations from the approved SAN architecture and design (Phases 1, 2 and 3), to include available options and recommendations.

b. A project schedule to integrate mainframe storage into the installed SAN architecture.



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2. In compliance with the accepted project schedule immediately above, integrate storage for one (1) of the State's three major data centers into the implemented SAN architecture (Phase 4 proof of concept). The contractor shall submit a Business Case that completely describes the Proof of Concept installation and the business and technical benefits that will be realized when Phase 4 is fully implemented.

3. Following a successful proof of concept (item B above) and in compliance with the accepted schedule, continue integration of mainframe storage into the implemented SAN of remaining mainframe systems.

Please reference Section 3.1.B.2.

3.2.A

The vendor shall be responsible for installing and certifying that the system(s) are ready to begin acceptance testing.

IBM is responsible for and will install and certify that the proposed system components are ready to begin acceptance testing.

3.2.B

Vendor must provide "all" items of the proposed system capable of meeting the requirements, specifications and functions identified herein.

The solution we have proposed is a complete solution, which fully meets the RFP requirements, specifications, and functions described, with the exception of the NCR server running MP-RAS Release 3.2.1 and the CPQ-ML370 server running Linux. Neither IBM, Brocade, nor McData currently support these servers for SAN disk attachment. We have submitted an RPQ to ask that these servers be supported. IBM is working with Brocade and McData to provide support for these platforms as soon as possible.

3.2.C

The proposed hardware must be new, unused, be currently manufactured, and be available from the manufacturer.

All of the proposed IBM hardware solution components are new, generally available, and currently being manufactured by IBM and our partners.



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3.2.D

The vendor must warrant all items delivered pursuant to this contract, unless noted otherwise herein, for at least one year following acceptance.

The Enterprise Storage Server (Shark) disk has a warranty of 3 years for 7x24 onsite service. The IBM 2109 (Brocade) switch and McData ED5000 Director each have a one-year warranty. IBM's proposed solution includes the cost of an additional two years of 7x24 onsite maintenance service discounted for prepayment.

The Netfinity Servers include three years onsite service. We have upgraded the onsite service to reflect two hour onsite response time. Diagnosis and problem resolution begins immediately when the call is placed to IBM.

3.2.E

The proposed solution must be able to accurately process date data from, into, between, and among the nineteenth, twentieth and twenty-first centuries, including calculating, comparing and sequencing dates and all related leap-year calculations.

The IBM solution components are Y2K ready. A product is Year 2000 Ready if the product, when used in accordance with its associated documentation, is capable of correctly processing, providing, and/or receiving date data within and between the 19th, 20th and 21st centuries including leap years, provided all other products (for example, software, hardware, and firmware) used with the product properly exchange accurate date data with it.

3.2.F

Vendors must provide, in their proposals, a description of the solution, including but not limited to:

The Technical Proposal Response Form references the locations of the sections which contain the detailed description of all the components of this solution. Additionally, there are product overview documents in Appendix B in this proposal.

1. Hardware components.

The hardware solution proposed includes the following hardware components: IBM 2105-F20 Enterprise Storage Server (ESS), Netfinity Servers, IBM 2109 Fibre Switches, McData ED-5000 Fibre Directors.



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2. Software elements and capabilities.

The IBM 2105-F20 Enterprise Storage Server has advanced software functions, including IBM StorWatch ESS Specialist, IBM StorWatch ESS Expert, PPRC (Peer to Peer Remote Copy), and FlashCopy (point in time copy software). See the product brief in Appendix B.

The StorWatch ESS Specialist software provides the customer interface for setup and management of the ESS.

The StorWatch ESS Expert provides capacity and performance monitoring of the ESS.

ESS Advanced Copy Services are provided by PPRC, XRC and FlashCopy.

The StorWatch Specialist for IBM 2109 Fibre Channel Switches is used to manage multiple fibre channel switches from a central console. See the product brief in Appendix B.

The EFC Software Manager is used to manage up to 36 McData ED-5000 fibre directors. See the product brief in Appendix B.

TSNM provides automatic discovery, monitoring and management of the SAN fabric and automated storage allocation in response to file system needs.

SANergy provides file sharing across a wide variety of operating systems and can be implanted as a high performance alternative to NAS and to implement server free backups.

VERITAS NetBackup has been included for the backup functions of the SAN.

3. Training (also list additional available on-going training with costs).

There are course descriptions in Appendix D for the following education courses.

We recommend the IBM class SS40A, "Enterprise Storage Server Implementation" for the IBM 2105-F20 Enterprise Storage Server.

We recommend the following IBM classes to provide adequate product knowledge and training for the SAN implementation:

- ♦ IBM class SS700, "Storage Area Networks (SANs): An Introduction"
- ♦ IBM class SS71A, "Implementing SAN Solutions"

We recommend the following McData classes



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McData Educational Services Course Summaries

SAN ESSENTIALS

- ♦ 1-hour live lecture briefing
- ♦ Offered from McDATA's website
- ♦ No charge

FIBRE CHANNEL SAN BASICS

- ♦ 1-day lecture
- ♦ Comprehensive technical introduction
- ♦ \$ 495

IMPLEMENTING SAN SOLUTIONS

- ♦ 2.5 day lecture and lab
- ♦ Intermediate training for SAN engineers
- ♦ Labs: FC-AL, fabric, bridge, SAN management
- ♦ \$ 1,395

DESIGNING THE SAN INFRASTRUCTURE

- ♦ 2-day lecture
- ♦ Step-by-step work project activities
- ♦ \$1,595

FIBRE CHANNEL PROTOCOLS

- ♦ 3-day lecture
- ♦ Analysis activities
- ♦ \$ 1,295

USING ENTERPRISE CONNECTIVITY

- ♦ 3 hour lecture and lab
- ♦ Hands-on activities with McDATA console manager
- ♦ No charge: conducted at the customer site



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We recommend the following Brocade education for the IBM 2109:

Course # Title	Duration	Price
FCH100 - Introduction to Fibre Channel and SANs	1/2 day	\$ 200
SWT100 - Silkworm Management for Operators	3 days	\$2,250
SAN100 - SAN Components	2 days	\$1,500
SWT200 - Silkworm Administration and Operations	3 days	\$3,000
SAN200 - SAN Design and Assessment	3 days	\$2,500
SWT300 - Silkworm Diagnostics and Trouble Shooting	2 days	\$3,000

We recommend the following VERITAS class

TC-NBU-ENT-MV2 NetBackup Enterprise Netbackup Training

This course is offered in 13 locations throughout the United States. We have included pricing for one staff person to attend an off-site class (travel and living not included). Alternatively, you may elect to have the course held on-site. As a complement to the traditional, instructor-led classes, new web-based training courses are now available for many of the VERITAS software products. Designed for customers who require basic training on products, but don't have the time to attend two or three-day sessions, these courses give a broad overview of all the capabilities of a particular product and offer detailed instruction on the most common features used on the job.

VERITAS Software is now also offering our Value Pass Program that provides your administrators the opportunity to take as many courses as they desire over a twelve-month period for one flat fee.

Additional class information available at the following websites:

<http://www.3.ibm.com/services/learning>

<http://www.mcdata.com/>

<http://www.brocade.com/>

4. Support

IBM and our partners offer local technical support personnel (storage system engineers) to answer questions and provide technical guidance and assistance. In addition, we provide 1-800 telephone support as part of our solution.

5. Installation planning.

IBM will conduct a formal System Assurance (SA) for all of the hardware and software solution components prior to installation. This is no additional cost to you. During the SA, a checklist of questions will be reviewed, and we will confirm all physical sites are ready to receive and install the proposed hardware and software.



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3.2.G

The contractor shall include in the proposal a written warranty and maintenance plan for providing system operation, system maintenance and upgrades, consultation, help desk services, training and support for the proposed solution. This plan shall include at a minimum:

3.2.G.1

Contractor contact, phone numbers (hot lines/800 numbers) and procedure required to report system outages/problems and to request help desk, consulting, training, promotion and support (including but not limited to systems analysis, programming and data base design services).

If a failure is suspected, call 1-800-IBM-SERV to open a ticket. You will be asked to provide the machine type and serial, along with your phone number. After the ticket is opened, you will be routed to our remote support center for problem determination and development of a repair action plan. A wealth of additional support services including, but not limited to, help desk, consulting, training, promotion and support (including but not limited to systems analysis, programming and data base design services) are available from IBM. Please go to <http://www.ibm.com/services> for more information and to request additional services; fees may apply.

3.2.G.2

A detailed listing of the system support services, policies and procedures to be provided including guaranteed service levels of each and any exceptions or exclusions from these services.

IBM provides 24x7 support with a 2 to 4 hour response objective for most products. Terms and Conditions are:

- ◆ Warranty Period: Three years.
- ◆ Warranty Service: IBM On-Site Repair (IOR)
- ◆ Warranty and maintenance Services for IBM Machines:

For each IBM Machine, we warrant that it:

1. is free from defects in materials and workmanship; and
2. conforms to its Specifications.

The warranty period for a Machine is a specified, fixed period commencing on its Date of Installation. During the warranty period, we provide repair and exchange Service for the Machine, without charge, under the type of Service we designate for the Machine.



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If a Machine does not function as warranted during the warranty period and we are unable to either 1) make it do so, or 2) replace it with one that is at least functionally equivalent, you may return it to us and we will refund your money. Maintenance Services for post warranty support:

We provide certain types of repair and exchange Service either at your location or at a service center to keep Machines in, or restore them to, conformance with their Specifications. We will inform you of the available types of Service for a Machine. We may repair the failing Machine or exchange it at our discretion.

When the type of Service requires that you deliver the failing Machine to us, you agree to ship it suitably packaged (prepaid unless we specify otherwise) to a location we designate. After we have repaired or exchanged the Machine, we will return it to you at our expense unless we specify otherwise. We are responsible for loss of, or damage to, your Machine while it is 1) in our possession or 2) in transit in those cases where we are responsible for the transportation charges.

You agree to:

1. obtain authorization from the owner to have us service a Machine that you do not own;
and
2. where applicable, before we provide Service —
 - follow the problem determination, problem analysis, and service request procedures that we provide,
 - secure all programs, data, and funds contained in a Machine, and
 - inform us of changes in a Machine's location.

When Service involves the exchange of a Machine or part, the item we replace becomes our property and the replacement becomes yours. You represent that all removed items are genuine and unaltered. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced. The replacement assumes the warranty or maintenance Service status of the replaced item. Before we exchange a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under our service. You also agree to ensure that the item is free of any legal obligations or restrictions that prevent its exchange.

Any feature, conversion, or upgrade we service must be installed on a Machine which is 1) for certain Machines, the designated, serial-numbered Machine and 2) at an engineering-change level compatible with the feature, conversion, or upgrade.



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Repair and exchange Services do not cover:

1. accessories, supply items, and certain parts, such as batteries, frames, and covers;
2. Machines damaged by misuse, accident, modification, unsuitable physical or operating environment, or improper maintenance by you;
3. Machines with removed or altered Machine or parts identification labels;
4. failures caused by a product for which we are not responsible; or
5. service of Machine alterations.

We manage and install engineering changes that apply to IBM Machines and may also perform preventive maintenance.

3.2.G.3

Hardware maintenance shall include routine service items (preventive maintenance) as recommended by the equipment manufacture(s).

All IBM recommended preventative maintenance and engineering changes, along with our superior repair strategies will be applied during the warranty and maintenance Services effective dates.

3.2.G.4

Software maintenance is to include: installation of any patches or other enhancements as they become available, upgrades as the department acquires them, system optimization or reconfiguration as necessary to maintain system performance.

Machine level code will be provided by IBM and installed at a mutually agreeable time. Upgrades, system optimization or reconfiguration as necessary to maintain system performance, if offered, will be available for an additional fee.

3.2.G.5

The vendor shall provide maintenance and support within one (1) hour of receiving a request for service.

IBM will respond by phone to your request for service within one hour as per agreed upon IBM Global Services SLAs put in place for the systems in each Phase as they are implemented . When our IBM Certified Technicians return your call, we will work with you to identify the problem, in many cases solving the problem during the call. If we need to dispatch a technician, we will do so with a two-hour onsite objective and with the objective of having the required repair part arrive with the technician by using the IBM Service Parts Distribution Network.



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In addition IBM recommends that the State of Iowa ITD increase the levels of support of current contracts as described below.

3.2.G.6

Vendor contact procedures and escalation procedures for system service and support.

IBM will provide support as per current State of Iowa ITD contracts and IBM warranty procedures including local support personnel available on-site or with response times as high as 4 hour fix (High Availability Service) depending on the level of support required for this contract. IBM prides itself on its proven track record of providing an industry leading level of customer support services and it's proven track record of meeting Service Level Agreements.

VERITAS Contact procedures and escalation procedures are all coordinated through 1-800-342-0652. To support Iowa ITD, VERITAS utilizes a tiered customer support system, tracking and prioritizing customer issues according to the level of support required. Specialized call-tracking methods are used to monitor the results of each call received and identify its current status. The implementation of worldwide call tracking, combined with eight call centers worldwide, allows VERITAS to incorporate a true follow-the-sun support strategy. VERITAS also employs an effective problem escalation process to ensure that customers are back up to speed quickly if they encounter problems. Questions that cannot be resolved by first-line support are escalated to a second-line technician who has in-depth knowledge of a particular product and operating system. The second-line technician, in conjunction with the VERITAS escalation team, will work diligently to provide quick resolution or, at a minimum, find the customer a viable work-around until permanent correction can be developed.

VERITAS extends its commitment to providing world-class technical support by maintaining a comprehensive knowledge base of FAQ's, troubleshooting tips, and technical support bulletins written by industry experts available to all customers via our web site or FaxBack service. Additionally, VERITAS technical support now offers customers its state-of-the-art remote interactive support service.

3.2.G.7

24 x 7 customer maintenance and support with a single point of contact for full system responsibility.

IBM provides 24 x 7 customer maintenance and support.



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IBM has many levels of service that we can provide on our products, but we suggest that the State of Iowa ITD purchase Support Line Advanced Support provided by IBM Global Services which can include many OEM products as well. See below for further description of Advanced Support and we suggest the State of Iowa ITD visit the following IBM web site <http://www-1.ibm.com/services/its/us/swsupport.html>.

VERITAS Technical Support Engineers are available to calls 24-hours-a-day, seven-days-a-week for the isolation and resolution of mission critical production issues. Our Customer Support Center can be reached at 800.342.0652. If you have a support related question, you can also email it to the following address: support@VERITAS.com

Premiere Direct Assist (PDAS) is for enterprise customers and provides:

- ♦ Entitlement to speak with VERITAS support technicians
- ♦ Unlimited toll-free telephone support
- ♦ 24 hours, 7 days a week support coverage
- ♦ Annual support contract
 - Unlimited named callers

3.2.G.8

Location of hardware / software service, support and spare parts.

IBM operates 60 Emergency Parts Stocking Centers (EPSC) in the United States to support our customers. In addition we also operate 84 Local Parts Storage (LPS) facilities in the U.S. as well as 12 Air Locations to dispatch parts in critical situations. Please see Appendix F with a map of service locations and competitive comparison data provided by outside sources. IBM also operates system and software support centers in Atlanta, GA and Dallas, TX which are fully staffed with support personnel 7x24 including phone support (Level 1) and dedicated Technical Support.

In addition IBM Global Services also offers services ranging from prime shift software support to Advanced Support, which provides a dedicated team available via phone 7x24 with specific knowledge of your environment. The Advanced Support service also offers proactive monitoring and regular reporting and updates provided through a single point of contact Service Manager assigned to your contract. This is service is the highest rated software support offering by any software or services company in the world today.



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3.3 Mandatory Requirements - Mainframe Storage

The Information Technology Department is seeking (1) one terabyte of external storage for attachment to its IBM MVS mainframes. This storage will not initially participate in the Storage Area Network, however the storage subsystems chosen must have the capability of being upgraded to native Fibre Channel (FICON) attachment. It is anticipated that at a future date, the mainframe storage will be connected into the fiber channel topology. The mainframe storage will not participate directly in the Storage Area Network but will use the Fibre Channel topology for data movement between the mainframe and open systems hosts.

The storage subsystem(s) must have the following capabilities and features:

3.3.A

The subsystem(s) must support attachment to the state's IBM mainframe processors (IBM 9672 R55).

The IBM 2105 Enterprise Storage Server (ESS or Shark) disk will attach to the state's IBM mainframe processors (IBM9672 R55). Attachment is via ESCON connections. FICON connection support is planned to be available in the Fall of 2001. FICON connections will be available as a field upgrade for installed 2105-F20 Sharks.

3.3.B

The subsystem(s) must have a minimum of (1) one TB (terabyte) of usable capacity with expansion capabilities to (5) five TB (terabytes).

The initial IBM 2105 will have a useable capacity of 1260GB. The IBM 2105 will expand to a current maximum useable capacity of 11.2TB. The ESS configuration proposed uses the industry's highest performing 36 GB HDDs attached via the Serial Storage Architecture (SSA) adapters. SSA adapters are superior to UltraSCSI adapters in that SSA provides superior performance (all disks can be transferring data simultaneously versus one disk at a time on a SCSI bus) and availability (a break in an SSA loop does not cause loss of access to data versus SCSI loss of access).



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The IBM 2105 Shark for S390 MVS attachment will have the following configuration:

2105-F20 ENTERPRISE STORAGE SERVER	1	
1802 S/390 PAV UP TO 2 TB	1	
2123 DISK EIGHT PACK 36.4 GB	6	
2715 REMOTE SUPPORT FACILITY	1	
3011 ESCON HOST ADAPTER	4	2 ESCON ports per adapter
4002 8 GB CACHE	1	
9301 MODEM COUNTRY GROUP M01	1	
9401 CONVENIENCE CORD C01	1	
9647 1,260 GB CAPACITY	1	
9854 THREE PHASE 50/60 HZ 60 AMP	1	
9870 NOMINAL AC VOLTAGE 200V-240V	1	

3.3.C.

The subsystem(s) must offer RAID-Protected storage (RAID-1 and RAID-5). This includes the option of spare disk assemblies that dynamically replace failed drives.

The IBM 2105 provides full RAID-5 protected storage. The IBM 2105 includes multiple 'Hot Spare' disk assemblies with all configurations. The 2105 'Hot Spares' are global 'Hot Spares' that will dynamically replace a failed disk drive.

3.3.D

The subsystem(s) must have a minimum of (8) ESCON channel attachments with expansion capabilities to (16) sixteen.

The IBM 2105 is configured with an initial eight ESCON connections. The IBM 2105 can have a current maximum of 32 ESCON connections.

3.3.E

The subsystem must be configured with sufficient cache to assure less than 10msec response times.

The IBM 2105 has been configured with 8GB of cache, which is a sufficient cache size to assure less than 10msec of response time for normal MVS workloads and a capacity of 1-4 TBs. For disk capacities greater than 4 TBs, the ESS can be field upgraded to a current maximum of 16 GB of cache.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.3.F

The subsystem must provide redundancy in its major component groups. The following redundancy is required:

The IBM 2105 is the most reliable disk available. The IBM 2105 has been designed with virtually no single point of failure and no single point of repair. It has remote support capability (two way call outbound & inbound) so that remote IBM support can be notified of events and can perform remote diagnostics. Many times the IBM CE will be dispatched automatically with information on which part to bring for replacement. Additionally, the IBM 2105 can be setup to send event notifications to customer personnel via email and pager as well as the normal OS console messages, IBM Service Director, and SNMP consoles.

1. N+1 power

The IBM 2105 provides N+1 redundancy of all hardware and FRU (Field Replaceable Units). This includes N+1 power.

2. N+1 cooling

The IBM 2105 provides N+1 cooling.

3. Redundant channel paths

The IBM 2105 provides redundant host connections and redundant access to internal storage clusters. The IBM 2105 storage clusters are redundant with fail over capability.

4. Redundant device paths

The IBM 2105 provides redundant device paths to the disk. Each 2105 Storage cluster has device adapters attached to disk. Each 2105 storage cluster and attached device adapters have redundant paths to all disk drives in the 2105.

5. Mirrored write cache

The IBM 2105 provides mirrored write cache. The IBM 2105 has two redundant storage clusters. Each 2105 storage cluster contains read cache and non-volatile, battery backed up, mirrored write cache. When the 2105 performs a write I/O operation, the I/O is written to cache on one of the 2105 storage clusters. The I/O is also written to non-volatile write cache on the other 2105 storage cluster.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.3.G

Concurrent Maintenance (all maintenance activity must be done concurrently while the subsystem is active on the host system. This includes dynamic replacement of the major component groups, capacity upgrades and microcode updates)

The IBM 2105 provides a fault tolerant, N+1 hardware architecture. This includes dual active processors, with fail-over switching, hot spares, hot swappable disk drives, nonvolatile fast write cache, and redundant power and cooling. The ESS is designed with no single point of failure or repair. Replacement of parts, microcode updates, and capacity upgrades can typically be done without interruption.

In addition, the IBM 2105 provides software called Sub-system Device Driver (SDD) code. SDD is no additional cost. SDD provides load balancing on two or more HBAs in servers. SDD will also provide fail-over capability if a server HBA fails, allowing the io to continue over the other HBA path to the 2105 storage.

3.3.H

Remote Maintenance (the subsystems must have remote capabilities for failure notification. This includes a Call-Home feature)

The IBM 2105-F20 provides a two-way (outbound and inbound) 'Call Home' feature. The 2105 has integrated functions to help prevent storage server downtime by constantly monitoring system functions. If a potential problem is detected, the IBM Enterprise Storage Server will 'Call Home' to report the problem. Remote IBM Support technicians can perform diagnostics. A technician can be dispatched to make repairs, often before the problem is noticed by data center.

3.3.I

The storage subsystems must offer a minimum of (3) three-year warranty, which includes parts and service.

The IBM 2105 provides an IBM 24x7, three-year onsite warranty. This includes all necessary parts and service.

3.3.J

The subsystem must have the capability of being upgraded to support FICON channel attachments.

The IBM 2105 will provide you the option to upgrade to native FICON channel attachments.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.3.K

The subsystem(s) must have a point-in-time copy feature

The IBM 2105 has advanced software to provide a point in time copy feature called FlashCopy. FlashCopy is a 'T0' copy technology, which allows the Primary, and Secondary copy to be immediately available for read and write update capability. The FlashCopy software can be accessed via the IBM StorWatch Specialist software and also via a command line interface. In a FlashCopy implementation, the secondary copy is also a fully protected RAID copy. This provides access to data and data integrity if a drive fails in the secondary copy.

Additionally, there is no limit to the number of copies of a source volume other than the maximum # of volume addresses which is currently 4096 per ESS.

3.3.L

Dynamic configuration (the subsystem(s) should be pre-configured with specified RAID Groups, RAID levels and logical volumes. However, the subsystem(s) must have the capability of dynamically changing its configuration under the control of the system administrator)

The IBM 2105 will initially be pre-configured based on the specifications the state provides us during the IBM System Assurance process. Using the StorWatch Specialist software which provides a web based interface, authorized customer storage administrator personnel can dynamically create, assign, and reconfigure the 2105 to your requirements. No IBM CE is required to change the disk definitions, and therefore there is no waiting nor cost for you to change the 2105 configuration.

3.3.M

The subsystem must support a minimum of 1024 logical volumes.

The IBM 2105 currently supports 4,096 logical volumes.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4 Mandatory Requirements - SAN Storage Console

The Iowa Information Technology Department (ITD) requires Professional/Technical Services to develop, install and test a Fibre Channel based Storage Area Network (SAN) that will be used initially for storage consolidation for a variety of Intel-Based and UNIX servers located on the Des Moines, Capitol Complex (campus). This SAN implementation is the first phase of a statewide Enterprise Storage Area Network, which will eventually include integration with other departmental storage networks and disaster recovery sites located around the State. This initial SAN implementation will be a campus-wide (10 kilometers) configuration, however the SAN design must have the capability of expanding to statewide distances via SAN/WAN/SAN and SAN/SAN connectivity. In the future, this SAN will connect to other SANs within the Des Moines state campus, to the Department of Transportation located in Ames (66 kilometers), other statewide departments and be used for the remote copy of data to various geographically dispersed Disaster Recovery sites. The SAN solution must provide centralized management of the fiber channel topology and allow for any vendor's storage (that supports fiber channel fabric attachment) and any vendor's servers (Intel-based and UNIX) to be installed on the storage network.

Additionally, the Information Technology Department is seeking one (1) terabyte of external storage for attachment to its IBM MVS mainframes. This storage will not initially participate in the Storage Area Network, however the storage subsystems chosen must have the capability of being upgraded to native Fibre Channel (FICON) attachment. It is anticipated that at a future date, the mainframe storage will be connected into the fiber channel topology. The mainframe storage will not participate directly in the Storage Area Network but will use the Fibre Channel topology for data movement between the mainframe and open systems hosts.

The Iowa Information Technical Department currently has over (50) fifty Intel-based and UNIX servers (Phase 1) with direct-attached storage. This project is a consolidation of storage on a Fibre Channel storage network where each server attached to the storage network will access its storage from a common storage pool.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.A. Server Types and Operating Systems.

3.4.A.1

The servers that must be initially attached (within ITD) to the storage network consist of Intel-Based servers (Compaq, Netfinity, NCR, Gateway) running Windows NT/2000 and Netware plus UNIX servers from IBM, Compaq (Digital), and NCR.

Server Types: IBM does provide support for Compaq, Netfinity, NCR, and Gateway servers running NT/2000 or Netware, plus UNIX from IBM and Compaq. An RPQ has been submitted for support of NCR MP-RAS.

3.4.A.2

The storage network must support these Intel-Based servers and Windows/Netware operating systems and UNIX servers and operating systems.

See answer in 3.4.A.3 below.

3.4.A.3

Future requirements of the storage network must support the major Intel-Based servers from IBM (Netfinity), Compaq, Dell and Hewlett-Packard plus support UNIX servers from IBM, Compaq, Hewlett-Packard, and Sun Microsystems. (The support of other Intel-based and UNIX servers will be viewed as a unique requirement and negotiated with the storage/SAN provider if/when the need occurs.)

IBM does support Intel-based servers and Windows/Netware OS, plus major Unix servers and OS's, including AIX, Tru64, HP-UX and Solaris. IBM is developing support for Linux on the ESS and will have this completed before the Proof of Concept phase deadline. The current 2.2 Linux Kernel does not have robust recovery procedures -- but RedHat is expected to address this in their 2.4 kernel. IBM is not responsible for Linux OS limitations on fibre channel support. Additionally, clustering for MSCS and HACMP is supported by the IBM Subsystem Device Driver that supports load sharing and load balancing.

All major Intel-based servers are supported.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.A.4

The solution provider must conduct an inventory of the servers and attached storage and resolve any differences between its inventory and the sever list supplied in this RFP.

IBM has reviewed the servers in Phase One and has noted the following servers that may not support a fibre channel host bus adapter. HBA's are PCI-based. Specifically, item 7, Compaq Prosigma 300 supports only EISA; Item 15, Compaq SP750 is a laptop that may not accept a PCI card unless a docking station is provided by the State. These servers may not be capable of fibre channel connectivity. IBM will continue to inventory and resolve further differences upon being selected as the successful bidder.

3.4.A.5

The State of Iowa Information Technology Department may also be conducting a server consolidation concurrently with the storage consolidation. Any server consolidation must be transparent to the storage consolidation. The Information Technology Department will ensure that any new server attached to the storage network will have Fibre Channel fabric capability and sufficient number of fiber channel HBA attachments to provide for redundancy. Any server that does not have Fibre Channel fabric connection capability is excluded from the storage network.

IBM will work with the State to ensure minimal disruption of storage consolidation to production environment and storage consolidation projects.

3.4.B

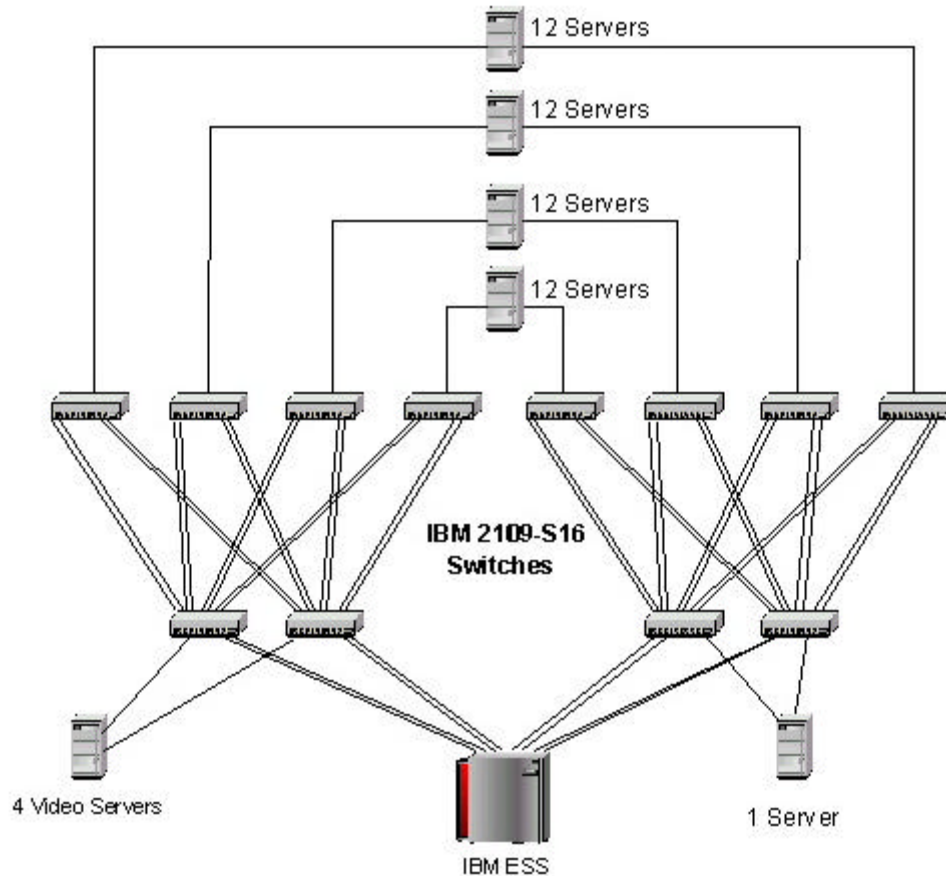
SAN design and Number of Servers. The initial Storage Area Network design and storage consolidation must be for approximately (50) fifty servers within ITD (Phase 1) and must have the capability of being expanded to support the Enterprise (through Phase 4).

IBM is responding with two designs for the 53 server Phase 1 requirements. They differ in that the first uses a 16-port switch as the basic fabric building block. This requires a tiered fabric design to provide redundant paths between server and storage. The second design uses a 32-port director as the building block. The switch-based fabric relies on redundant paths to provide high availability. The director-based fabric utilizes both redundant paths and highly available hardware configurations to maximize connectivity and performance in case of failures in the fabric or server/storage HBAs.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

The first SAN design is a fabric built with twelve IBM 2109-S16 switches.



Phase 1 Design using IBM 2109-S16 Switches

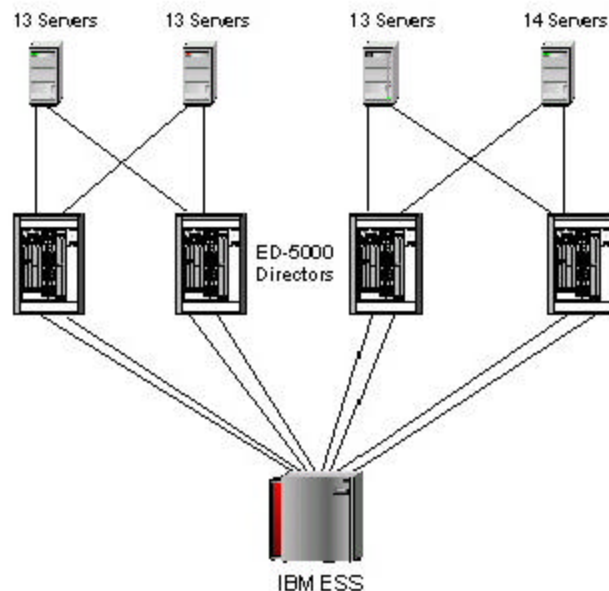
This design provides 192 fibre ports with redundant paths for up to 60 servers, 8 connections to the storage subsystem and 64 interswitch connections. This fabric can be expanded by adding additional switches in either the server or storage tier.

The IBM 2109 supports full fabric login (F) ports, FC-AL (FL) ports, and switch-to-switch (E) connection ports. The proposed switches have redundant fans and power supplies to provide a 99.9% available environment.

The second SAN design uses four McData ED-5000 Directors.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS



Phase 1 Design using McData ED-5000 Director

This design provides 128 fibre channel ports to support up to 60 dual-connected servers with 8 connections to the storage subsystem. This SAN fabric can be expanded with additional directors supporting more servers or storage subsystems.

The proposed McData ED-5000s have redundant fans, power supplies, management, control and switch processors to provide a highly available 99.999% environment.

The McData ED-5000 supports full fabric login (F) ports, and switch-to-switch (E) connection ports. If FC-AL (FL) connection ports are required with the McData design, we recommend front-ending the ED-5000 with the McData ES-1000 switch. ES-1000 information is included in the pricing attachment.

IBM has announced the ED-5000 will provide support for FICON attachment of S/390 devices and has made a Statement of General Direction that the ED-5000 will support the intermix of both Fibre Channel (FCP) and FICON protocols pending the completion of interoperability validation.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.C

Storage Network Topology. The storage network must be based on open standard Fibre Channel. Today there are multiple industry organizations involved in creating standards for storage, storage management, SAN management and interoperability. In storage networking we view SNIA (Storage Networking Industry Association) as the largest and most influential industry organization in the SAN standards area. As standards in storage networking are currently being developed, we will define open standards as the following:

IBM is a founding and active member of SNIA, and is fully committed to supporting open standards for SAN connectivity of multivendor fabric, storage, and server products. IBM has established relationships with all major vendors to be able to provide diagnostic support for multivendor SANs.

3.4.C.1

The SAN design must support attachment of any fabric-capable storage to the storag network.

IBM is specifically committed to supporting storage products from multiple vendors into the SAN. Our management software (Tivoli) and heterogeneous file-sharing software (SANergy) support a large range of vendors' products. There is nothing in our storage products (disk, tape, optical, etc) that are designed to exclude other storage products.

3.4.C.2

The SAN design must support attachment of any Intel-Based and UNIX server capable of fabric attachment.

IBM works quickly to support multivendor server (and storage) attachment to our open SANs, and has over \$50M of OEM equipment in our interoperability-testing lab to support this work.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.C.3

De-facto standards (eventually moving to formal standards) are defined as standards in practice being used by the major server and storage vendors and endorsed/tested by SNIA. Standards, when available, must be followed. The standards of most importance are the interoperable hardware interfaces and application programming interfaces.

IBM supports all major standards, including SNIA and ANSI T11. ANSI T11 standards define means to provide the information used by management tools for topology discovery, element monitoring, and change management and reporting. Both inband and out of band (SNMP) standards are supported.

3.4.C.4

The interoperability of the fiber channel components (switches, hubs, bridges, Host-Bus-Adapters) used in the storage network must have been tested at the vendor's or a third party interoperability lab.

IBM has extensive interoperability testing labs in US, Europe, and Asia. In addition, IBM has assisted our storage business partners in opening up over 60 SAN interoperability-testing labs in their offices in 2000, and more are planned for next year. All designs recommended by IBM have been fully tested prior to being published.

3.4.D Storage Network Ports.

3.4.D.1

The storage network will initially require approximately (120) one hundred twenty fiber channel ports. Our estimate of the ratio of switch to hub ports is: 2/3-switched ports and 1/3-hub ports.

Both design options presented in section 3.4.B provide 120 server ports and 8 storage subsystem ports. Switches were selected for all ports due to the performance and configuration flexibility of switches as compared with Fibre Channel hubs.

3.4.D.2

The storage network design must provide switch and hub components to meet the port count and performance requirements.

Both design options in section 3.4.B provide the required port count to support Phase 1.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.D.3

The storage network must have the capability of expanding to 3X the number of ports for future expansion.

The storage network can expand to 3x the number of ports by adding switches to the fabric.

3.4.D.4

The SAN must have SAN-to-SAN and SAN-WAN-SAN connectivity.

The switches used in these designs can support SAN-SAN connections using long-wave fiber GBIC with connections up to 10km. Fiber channel extenders like the Finisar Optilink2000 and Wave Division Multiplexor like the IBM Fibersaver can provide extensions up to 120 kilometers. Fibre Channel to ATM routers from CNT and Crossroads can provide SAN-WAN-SAN connections between fibre channel switches over private and public facilities. See Section 3.4.G.

3.4.D.5

The expansion of the topology must have the capability of adding/removing fiber channel components without the loss of redundancy or performance.

Both design options use multiple paths between server and storage through the fabric allowing changes to be made to the fabric without disrupting service. This assumes the server operating systems support either multi-path load balancing or non-disruptive fail-over for multiple HBAs.

3.4.E

Storage Network Redundancy.

3.4.E.1

The fiber channel topology must provide full redundancy so that no single path or fiber channel component (switch, hub, Bridge, HBA) failure can prevent access to the storage pool.

The Phase 1 SAN options presented include redundant switches and redundant HBAs. The IBM 2109 provides redundant power supplies and fans. The proposed McData ED-5000s has redundant power supplies and fans and in addition, redundant management, control, and switch processors to provide a highly available fabric.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.E.2

Those applications (e.g. video) having specific performance requirements must be configured with sufficient paths to maintain performance in the case of path or switch failure.

The Phase 1 designs provide multiple paths from server to storage through the fabric to insure application availability and performance. In the design using the IBM 2109, the attachment of the video servers directly to the storage tier switches will insure the highest degree of performance in the case of path or switch failure.

3.4.E.3

Each attached server on the storage network must be configured with a minimum of two Fibre Channel paths, a primary and secondary path.

The Phase 1 SAN designs provide two paths to every server.

3.4.F

Storage Network Guaranteed Bandwidth. The storage consolidation will include at least one video application. Any video application attached to the storage network must have guaranteed bandwidth.

Video applications typically use IP-level requests for guaranteed bandwidth. There are several prioritization protocols used in TCP/IP networks and this will require attention to the router and switch vendors' capabilities in the State's WAN and LAN technologies. Fibre Channel architecture provides support for a Class 4 traffic designed to support Video, but to date we are aware of no application vendors who exploit this ability. The standards for video support over FC have not been finalized, however Brocade has been active in this area and provides a proprietary means of a) supporting Class 4, multicast traffic, b) dedicating inter-switch link (ISL) connections to specific hosts to avoid having to share ISL's with other traffic that may improve video quality, and five prioritization levels. These techniques have been submitted to standards committees, and Brocade has had much success leading the development of switch standards in this manner, having submitted 14 of 17 standards relating to FC switches. IBM supplies the Brocade products, always at current levels, as our IBM 2109 product. Other vendors, including McData (IBM 2032), often wait for ratification before developing compliant products. Using the techniques described above, IBM can support video QoS to the extent possible by ensuring adequate storage access and delivery rates.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.G

Storage Network Distance Requirements. The initial storage consolidation will be a campus environment (10 kilometers). However, the storage network must have the capability for attachment to other storage area networks located across the state. The storage network must provide for SAN-To-SAN (distances up to 100 kilometers) and SAN-WAN-SAN (distances greater than 100 kilometers) attachments.

IBM provides a wide range of distance solutions for Fibre Channel networks. Multimode GBICs can support up to 500 meters, and longwave GBICs typically up to 10km without fibre extenders, and over 100km with fibre extenders. The IBM 2029 Dense Wave Division Multiplexer can be used to provide up to 32 FDX channels (2.4Gbps per channel) over a fibre pair, or 64 FDX channels over 2 pairs, to provide 50km point-to-point or 35km hubbed ring configurations to support any combination of ESCON, FICON, Sysplex Timer (ETR), Coupling Links (ISC), Fibre Channel, FDDI, Fast Ethernet, OC-3, OC-12, and Gigabit Ethernet.

IBM partners with CNT to deliver fibre channel SAN solutions of unlimited distance using the CNT Ultraset Open Systems Gateway. This device supports both SCSI and Fibre Channel hosts and storage devices, and supports ATM services at speeds of T1, T3, and OC-3. The ATM interface supports 1024 Permanent Virtual Circuits (PVC) to efficiently support large multisite configurations. These solutions are tested in our interoperability labs.

SAN over IP solutions have been proposed by other suppliers but are not currently available. With current technology capabilities, in the next year or two these technologies will only be usable for situations such as file transfers or backups where response times are not critical. This is due to the inconsistent delays inherent in IP networks. Though this delay is minimized at higher speeds available on some private networks, initial development will typically focus on speeds below 1Gbps.

3.4.H

Fibre Channel Components - The storage area network solution provider must supply all SAN components (switches, hubs, bridges, host-bus-adapters, fiber infrastructure) and insure their interoperability. The solution provider must provide for the term of the contract a standard cost structure for the SAN components to include, but not limited to switches, hubs, host bus adapters, port types, WAN connectivity, and fiber.

A list of SAN components is included in Appendix G, CP2.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.I

Storage Capacity Requirements.

3.4.I.1

Vendors must configure the initial capacity of the SAN for ITD for (3) three terabytes of useable disk storage (storage pool).

An IBM 2105, Enterprise Storage Server (ESS), with 3360GB useable disk capacity, eight fibre connections will be provided for the initial capacity of the SAN for ITD. The configuration includes the following:

2105-F20 ENTERPRISE STORAGE SERVER	1
2123 DISK EIGHT PACK 36.4 GB	16
2716 REMOTE SUPPORT FACILITY ATTACH	1
3022 FIBRE CHANNEL SHORT WV.ADAPTER	8
4002 8 GB CACHE	1
9401 CONVENIENCE CORD C01	1
9643 3,360 GB CAPACITY	1
9854 THREE PHASE 50/60 HZ 60 AMP	1
9870 NOMINAL AC VOLTAGE 200V-240V	1

3.4.I.2

The initial (ITD) storage network must allow for the storage pool to expand to (20) twenty terabytes in the future.

The proposed storage network architecture will allow ITD to easily expand to 20+ terabytes in the future. The IBM 2105 will expand to 11.2TB of useable disk capacity. To handle additional disk growth requirements, an additional 2105 or other disk may be attached to the storage network.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.J

Storage Subsystem Requirements. The storage subsystem(s) comprising the storage network storage pool must have the following characteristics:

3.4.J.1

RAID protected storage (subsystems must support RAID-5 and RAID-1 running concurrently on the subsystem with the option of active spare disk drives)

The IBM 2105 provides full RAID-5 protected storage. The IBM 2105 includes multiple 'Hot Spare' disk assemblies with all configurations. The 2105 'Hot Spares' are global 'Hot Spares' that will dynamically replace a failed disk drive.

3.4.J.2

Native Fibre Channel host interface support with support of Fibre Channel fabric attachments, Class-2 service.

The IBM 2105 provides native fibre channel host interface support, with support for fibre channel SAN fabric, class 2 service, fibre point to point, and FCAL connectivity options.

3.4.J.3

Redundant components or redundancy for its major component groups. This includes the following:

a. N+1 power

The IBM 2105 provides N+1 redundancy of all hardware and FRU (Field Replaceable Units). This includes N+1 power.

b. N+1 cooling

The IBM 2105 provides N+1 cooling.

c. Dual-Active controllers with failover (failover may be host-based)

The IBM 2105 provides redundant dual-active controllers (clusters), with fail over capability.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

d. Mirrored write-caches

The IBM 2105 provides mirrored write cache. The IBM 2105 has two redundant storage clusters. Each 2105 storage cluster contains read cache and non-volatile, battery backed up, mirrored write cache. When the 2105 performs a write io operation, the io is written to cache on one of the 2105 storage clusters. The io is also written to non-volatile write cache on the other 2105 storage cluster.

e. Redundant host interfaces

The IBM 2105 provides redundant host interfaces. Each 2105 host interface is connected to both of the IBM 2105 dual active controllers.

In addition, the IBM 2105 provides software called Sub-system Device Driver (SDD) code. SDD is no additional cost. SDD provides load balancing on two or more HBAs in servers. SDD will also provide fail-over capability if a server HBA fails, allowing the io to continue over the other HBA path to the 2105 storage.

3.4.J.4

Dynamic configuration (the subsystems should be pre-configured with specified RAID Groups, RAID levels and LUN sizes when installed on the storage network. However, the subsystem(s) must have the capability of dynamically changing its configuration under the control of the system administrator).

The IBM 2105 will initially be pre-configured based on the specifications the state provides us during the IBM System Assurance process. The 2105 via the StorWatch Specialist software will provide users the ability to dynamically create, assign, and configure the 2105 to your requirements. No IBM CE is required to change the disk definitions, and therefore there is no waiting or cost for you to change the 2105 configuration.

3.4.J.5

Concurrent Maintenance (all maintenance activity must be done concurrently while the subsystem is active on the storage pool. This includes dynamic replacement of the major component groups, capacity upgrades and microcode updates).

The IBM 2105 provides a fault tolerant, N+1 hardware architecture. This includes dual active processors, with fail-over switching, hot spares, hot swappable disk drives, nonvolatile fast write cache, and redundant power and cooling.

IBM 2105 maintenance can be done concurrently, including Licensed internal code, and dynamic replacement of major components including disk capacity upgrades, adapters, power, cooling, and cache.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.4.J.6

The storage subsystems must support Variable LUN sizes up to 500GB LUNs (The importance is the LUN presented to the application server. If the storage network management controls the presentation of logical LUNs to the attached servers transparent to the physical LUNs on the subsystems, this is fully acceptable).

The IBM 2105 provides users complete flexibility in the size of LUNs. IBM 2105 LUN sizes have granularity to 100MB. LUN sizes can be as small as .1GB up to the useable disk available in a given disk array. The largest LUN sizes supported by the 2105 are 225GB.

Larger LUN sizes can be created by using host software to create volume sets, or by using software in the storage network to combine LUN sizes to create a larger LUN.

3.4.J.7

Remote Maintenance (the subsystems must have remote capabilities for failure notification. If the remote notification is integrated into a SAN management facility which includes the storage subsystems, this is fully acceptable).

The IBM 2105-F20 provides a 'Call Home' feature. The 2105 has integrated functions to help prevent storage server downtime by constantly monitoring system functions. If a potential problem is detected, the IBM Enterprise Storage Server will 'Call Home' to report the problem. A technician can be dispatched to make repairs, often before the problem is noticed by data center.

3.4.J.8

The storage subsystems must offer a minimum of (3) three-year warranty, which includes on-site service and parts.

The IBM 2105 provides an IBM 24x7, three- year onsite warranty. This includes all necessary parts and service.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.5 Mandatory Requirements-SAN Management

The most important element of this storage network is its management. The SAN management is defined as facilities (hardware, software or both) allowing the systems administrator to view, monitor and manage the storage pool.

SAN Manager: The SAN Manager, sometimes referred to as an appliance, is a computing element attached to the storage network or software running on an attached server that allows administrators to create logical connections between host systems and logical units (LUNS) on the storage network. The SAN Manager allows an administrator to view all of the SAN attached storage as a single, virtual storage pool and add or subtract storage from a host dynamically.

3.5.A

The following are mandatory requirements for the SAN Manager element:

3.5.A.1

The storage consolidation must include a SAN management element as described above. The SAN management element can be either a separate appliance attached to the SAN or software running on a server attached to the SAN. Contractors are to describe which implementation methodology they are proposing.

Tivoli Storage Network Manager runs on a WIN2000 server and provides the SAN management element. The NT platform is also supported.

3.5.A.2

The SAN management element must be redundant.

3.5.A.2.a

In the case of an appliance (computing element attached to the SAN), the appliance must be clustered.

IBM has proposed two Netfinity 5100 Servers to be configured with VERITAS Cluster Manager to support high availability.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.5.A.2.b

If the SAN management is running on an attached server, the server control must have failover capabilities to another server.

Yes, the Tivoli Storage Network Manager (TSNM) server can be either Windows NT or Windows 2000. For failover capabilities, TSNM runs on a Windows NT or Windows 2000 clustered environment and acts like any other Windows application in a clustered environment.

3.5.A.3

The SAN management element must provide a common discovery agent for fabric monitoring and management.

3.5.A.3.a

The common discovery agent must perform in-band and out-of-band monitoring, and management of systems, storage, and the SAN fabric elements.

Yes, TSNM supports both *in-band* and *out-of-band* monitoring, and management of systems, storage, and the SAN fabric elements.

3.5.A.3.b

The SAN management element must support the SNMP MIBs via an out-of-band connection and the Fibre Channel management MIB (switch link tables and zoning) via in-band paths.

Yes, TSNM supports the SNMP MIBs for those switches that pass the required information via an out-of-band connection and the Fibre Channel management MIB (switch link tables and zoning) via in-band paths.

3.5.A.4

The SAN management element must provide topology mapping (switch zones, host-to-storage and storage-to-host mappings)

Yes, TSNM provides topology mapping (switch zones, host-to-storage and storage-to-host mappings).



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.5.A.5

The SAN management element must provide Event Monitoring. (The collection and consolidation of events, fault-isolation and problem determination in the SAN).

3.5.A.5.a

The event management element must have drill-down capability to view configuration information, alert and failure information.

Yes, TSNM has drill-down capability to view configuration information, alert and failure information.

3.5.A.5.b

The event monitoring must have remote capabilities.

Yes, the TSNM event monitor has the ability to send traps to a remote SNMP manager or Tivoli TEC console.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.6 Other Storage Network Features

3.6.A

LAN-Free Backup. The storage consolidation must provide for a LAN-Free Backup function. At the direction of a server, tape, optical, or disk storage pools can be dynamically allocated to clients allowing backup, archive, or hierarchical space management information to be sent across the SAN directly to storage pools.

LAN-Free Backup is accomplished using Netbackup's Shared Storage Option (SSO). SSO is the industry's first heterogeneous storage area network solution that allows individual tape drives to be shared dynamically between multiple VERITAS NetBackup servers. The drives are connected to each host via enabling hardware, such as switches, hubs, multiplexors, or bridges. SSO allows the enterprise to leverage their peripheral investments more thoroughly through drive sharing, since individual drives need not be tied to a specific server anymore, and through better usage of the hardware.

3.6.B

Remote Copy. The storage consolidation must provide for the remote copy of LUNs or files across the SAN infrastructure.

The IBM 2105 has advanced software, Peer-to-Peer Remote Copy (PPRC), to provide a remote copy of data. This allows a LUN or file to be copied across the SAN infrastructure. The IBM 2105 PPRC software provides a synchronous copy of the data, with guaranteed data integrity.

3.6.C

Point-In-Time Copy. The storage consolidation must provide a point-in-time copy solution for the attached application servers.

The IBM 2105 has advanced software to provide a point in time copy feature called FlashCopy. FlashCopy is a 'T0' copy technology, which allows the Primary, and Secondary copy to be immediately available for read and write update capability. The FlashCopy software can be accessed via the IBM StorWatch Specialist software and also via a command line interface. In a FlashCopy implementation, the secondary copy is also a fully protected RAID copy. This provides access to data and data integrity if a drive fails in the secondary copy RAID group.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.6.D

Removable Media Sharing. (The storage consolidation must provide for tape resource sharing on the SAN. Removable Media sharing allows any application running on an attached application server to share removable media, drives and automation.

Removable Media Sharing is also accomplished using SSO from VERITAS. A dedicated Fibre Channel Arbitrated Loop within a Storage Area Network provides the flexibility to run backup operations more frequently, instead of being restricted to off-peak network times. VERITAS Software's Shared Storage Option (SSO) allows multiple distributed backup servers to share common, centralized storage devices for greater cost efficiency and fault tolerance. Each backup server can initiate its own backups and restores regardless of the state of the other backup servers.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.7 Evaluated Items, Features and Considerations

The following Items, Features and Considerations, of proposals meeting all mandatory requirements, will be further evaluated as specified below. Several of the items/features are not generally available, in which case a description of the item/feature and its general availability date can be used.

3.7.A

Mainframe Storage Items, Features and Considerations

3.7.A.1

The availability of data duplication software, PPRC and point-in-time copy, supporting a re-synchronizing capability.

The proposed IBM 2105 has generally available, advanced firmware including PPRC and FlashCopy (point in time copy) software. FlashCopy provides an almost instantaneous full copy. Therefore, re-synchronization is accomplished by an almost instantaneous new re-copy.

3.7.A.2

The ability to support storage partitioning with open-systems hosts. This includes native Fibre Channel attachment.

The IBM 2105 will allow you to partition disk between S/390 hosts and open system hosts. Both S/390 and open hosts can share the same 2105. This includes fibre channel attachments.

3.7.A.3

The ability to support additional logical volumes (4096)

The IBM 2105 currently supports 4096 logical volumes.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.7.B

SAN Items, Features and Considerations

3.7.B.1

Server-Free Data Movement (Server-free data movement is the exploitation of the SCSI copy extensions for server-free data movement within the SAN. This is a desirable feature for the storage consolidation).

VERITAS plans on releasing VERTEX in early 2001. A description of the VERITAS VERTEX initiative is included in Appendix B.

3.7.B.2

Heterogeneous File Sharing (The ability of sharing files between heterogeneous open system servers attached to the SAN. This includes the appropriate locking mechanisms)

Tivoli SANergy is patented software that runs on the computers connected to a SAN that

- ◆ Provides a scalable NAS solution, but with up to 20 times the performance
- ◆ greatly simplifies SAN-storage administration by eliminating the individual partitioning and resizing of volumes associated with centralized storage
- ◆ can reduce the total amount of storage required in a SAN
- ◆ supports major file systems without introducing a proprietary storage format
- ◆ Delivers serverless backup and restore

Scalable NAS - Network Attached Storage is known for its simplicity of administration, but its performance is constrained due to the use of LAN I/O, high overhead protocols and small packet lengths for the transmission of files. Disk I/O uses large packet sizes and low overhead format to deliver up to 20 times the performance of LANs when compared to gigabit Ethernet, and even faster compared to others. SANergy fits seamlessly into the role of the NAS, but exploits the SAN for the delivery of actual file data directly to the requesting server. SANergy takes the NAS model of a storage server with direct attached disk and inserts a SAN between the server and disk (see Figure 1).

Other servers are also attached to the same SAN. As requests to send or receive files are received over the LAN interface, the SANergy server, called the Metadata Controller (MDC), redirects the file I/O over the SAN to the requesting server. Client code on each SAN-attached server supports this redirection, and runs on a wide variety of operating systems. Servers or clients not SAN-connected that request files are responded to by sending the file over the LAN, which also serves as backup in case of a SAN failure. To further support high availability, a second server can be configured as backup to the main SANergy MDC server.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

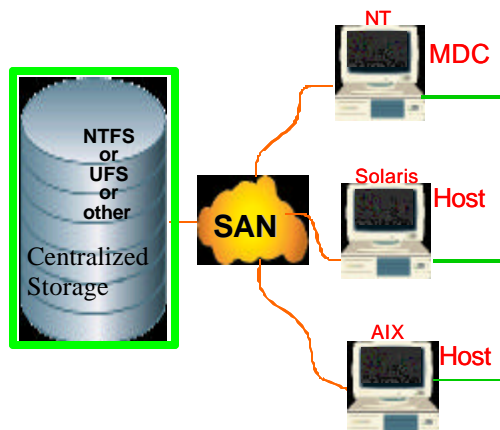


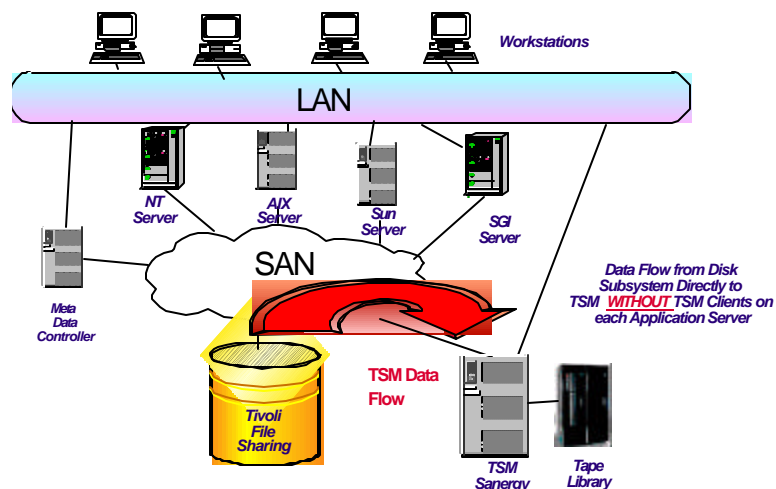
Figure 1

Simplified Storage Administration – Today's trend is to consolidate storage, moving from direct attached disks to centralized storage. However while this approach does focus the administration of storage, it still requires setup and changes to partitions assigned to each server. These fixed partitions typically waste storage space, and usually require moving data and reformatting disks to increase the size of a volume as data grows. Tivoli SANergy eliminates the one-to-one relationship between the number of SAN-connected computers and the number of disk volumes needed by those computers.

Tivoli SANergy transparently enables multiple computers to share single disk volumes on the SAN-storage. In fact it allows many combinations of computers running Windows NT, Windows 2000, MacOS, Irix, Solaris, AIX, Tru64, RedHat Linux and DG/UX to all share the exact same disk volumes at the same time—across platforms. The SANergy server stores all files in a standard file system. Requests from dissimilar file systems are handled using protocols like CIFS or NFS. Access to files is via normal network-based file requests, so the same security controls used on the LAN will control access to files over the SAN. No changes are necessary. No new security tools to learn. And if the applications running on those computers are capable, Tivoli SANergy even enables the sharing of the exact same files at the same time—across platforms! Additionally, the partition that SANergy uses as NAS storage can be apportioned out of a larger shared storage device. For example, part of an IBM ESS ("Shark") can be used for MVS storage, while other LUNs can be used by SANergy as NAS storage. This results in much more efficient utilization of file storage space. No other vendor offers this level of integration of NAS, SAN, and centralized storage using non-proprietary file formats.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS



Serverless Backup - most tape backup systems today are controlled by a dedicated backup server with direct-attached tape. One of the first advances in SAN is to attach the tape drive directly to the shared SAN, but still have the dedicated backup server control access to the tape drive. This requires additional code from the backup software manufacturer on each server being backed up. When SANergy is installed on the tape backup server, SANergy can redirect files stored on disk directly to tape regardless of the file ownership. In this case, you do not need to have special backup software installed on each server. Both backup and restore is controlled by the backup software, with SANergy providing the I/O redirection as required.

In summary, Tivoli SANergy couples the maturity, security, and inherent sharing abilities of industry-standard LANs with the guaranteed delivery, high bandwidth, and low-processor overhead of SANs. Tivoli SANergy is unique in that it is based upon the standard file systems and network services provided by the operating systems that it supports. By leveraging existing standards, Tivoli SANergy still allows you to use all of the access control and security features of your network while ensuring maximum compatibility with existing and future applications and management utilities.

By combining the high-throughput capabilities of modern SAN technologies with the ability to share physical storage devices across multiple machines, Tivoli SANergy makes possible entirely new applications and work flows, while reducing the deployment costs of multiple-server environments. Whether supporting real-time streaming access to digital video files or moving gigabytes of files through a production workflow, or offloading your LAN and servers by delivering server-free backups, Tivoli SANergy can save precious seconds, minutes, or hours in the production and delivery of digital information.

Tivoli SANergy enables you to reduce or eliminate the expense of redundant storage and the overhead of data synchronization in multi-host environments, such as large-scale web or file servers. Tivoli SANergy enables truly scalable and cost-effective network and server expansion with no performance impact.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

By extending the capabilities of standard file systems, such as NTFS, and leveraging the inherent access control and capabilities of modern operating systems, Tivoli SANergy transparently accelerates while affording maximum compatibility. Issues such as namespace, user access control, and file system interoperability are left to the powerful, intrinsic capabilities of Microsoft® Windows NT, Apple Macintosh, and UNIX technology, while Tivoli SANergy manages the cross-platform synchronization of file system caches, data striping, and concurrency.

In addition to leveraging existing software standards, Tivoli SANergy is virtually independent of the underlying storage area network media, requiring only SAN support of multi-initiator access to the storage devices on the network. There is no tie-in to specific host bus adapters, switches, hubs, or even technologies—customers can choose from virtually any flavor of a SAN, including switched or shared Fibre Channel Arbitrated Loops (FC-ALs) or fabrics, shared SCSI, or SSA. Tivoli SANergy works equally well with high-performance RAID devices, simple JBOD arrays, and even supports NTFS software striping across all platforms for maximum performance. But the Tivoli SANergy commitment to standards doesn't stop with compatibility. Tivoli is committed to making SANergy the industry-standard platform for shared storage, and we will undertake many initiatives to promote and extend this standard to meet the needs of the changing marketplace.

Supported File Systems for the MDC: In the 2.2 release, Tivoli SANergy employs the native Windows NT and Windows 2000 file system—NTFS (and related administration/management tools), the native Solaris file system—UFS, and the native Red Hat Linux file system—EX2FS. The MDC partition can also be formatted using LSCi's "QFS" and "SAMFS".

Supported file systems for SANergy hosts: Same as for MDC, plus MAC OS, and DG/UX, AIX, IRIX, Compaq Tru-64.

While Tivoli SANergy is operationally an extension of the file system, it operates entirely independent of the data formats within the files themselves. Files can be digital video or audio, PostScript, HTML, executable applications, whatever—to SANergy it's all just a bunch of bits that some user or application needs to get to.

Over 5000 licenses of Tivoli SANergy are in use around the world on more than 1000 SANs. SANergy is independent of any specific SAN fabric or storage hardware.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.7.B.3

Policy-Based File Lifecycle Management (Using a set of customizable policy definitions, administrators can define rules that govern the detection of lifecycle changes and the actions that should be taken when these changes happen)

Yes, the Tivoli Open System Managed Storage facility has Policy-Based File Lifecycle Management. You will be able to use a set of customizable policy definitions, in which administrators can define rules that govern the detection of lifecycle changes and the actions that should be taken when these changes happen. The Tivoli Open System Managed Storage has been announced and is targeted to be available in late 2001.

3.7.B.4

Policy-Based Data Placement (Using a set of customizable policy definitions, administrators can define rules that govern the placement of data as it is created)

Yes, the Tivoli Open System Managed Storage facility has Policy-Based Data Placement. By using a set of customizable policy definitions, administrators can define rules that govern the placement of data as it is created.

3.7.B.5

NAS Attachment (The ability to attach Network Attached Storage onto the SAN. This includes NAS backup and restore)

The following information is proprietary and confidential and should not be released.

In February 2001 IBM will announce the ability to attach NAS product to SAN for backup and restore. Initially this will be via native SCSI. The subsequent development will enhance these options.

3.7.B.6

Automatic Disk Allocation (Using a set of customizable policy definitions, an administrator can define rules that govern the monitoring of file systems and the pro-active actions that are to be taken to avoid out-of-space conditions)

TSNM provides this function.



E. ADMINISTRATIVE, CONTRACTUAL AND MANDATORY REQUIREMENTS

3.7.B.7

Automated Capacity Analysis (An automated summary of data growth, storage capacity growth and free space by attached server, operating system, file system type and file system. Predict when the storage pool will run out of capacity by host, operating system and file system)

IBM has plans to enhance Tivoli Decision Support with the capability to do automated capacity analysis in 2001.

3.7.B.8

Automated Performance Analysis (Using a set of customizable policy definitions, performance analysis questions can be answered)

IBM has plans to enhance Tivoli Decision Support with the capability to do performance analysis in 2001.

3.7.B.9

Capacity Usage Charge-Back (The ability to track capacity use by attached server and generate charge-back reports)

The StorWatch Expert software gathers and reports capacity and performance information on all Shark disks in the network. This includes information about capacity use by attached server. The data is maintained in a DB2 database. StorWatch and the DB2 database run on an NT or AIX server. Capacity information from the StorWatch DB2 database can be extracted. The extracted records can be used as input to your existing charge back system. The StorWatch Expert has been included in this proposal.

Additionally, IBM has plans to enhance Tivoli Decision Support to provide a capacity and performance reporting tool for the Tivoli Storage Network Manager (TSNM is included in this proposal to manage the SAN). This new tool will be a separately priced software program. It will gather and report capacity and performance information on all disk and tape devices, regardless of vendor, that are attached to the SAN managed by TSNM. This information can also be used as input to your charge back system. The new tool is targeted to be available in 2001. Since this tool is not yet announced, we are unable to commit on a price and availability date at this time.



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3.7.B.10

Attachment of Current Storage Subsystems (The State wants the capability of attaching owned or leased storage assets, currently direct attached to servers, to the network storage pool. This assumes that these subsystems have Fibre Channel support or can be field-upgraded to support Fibre Channel)

IBM will work with you to redeploy as many of your current storage devices as practical in the IBM "open" SAN environment. IBM's SAN hardware, software, and services solution is an "open", nonproprietary solution. IBM's SAN supports both IBM and non-IBM storage devices and servers to provide any-to-any connectivity. IBM has invested \$400M in building a SAN Interoperability Lab in Gaithersburg, MD. This lab is available to customers for integration testing of servers, storage devices, and FC switches in a SAN environment. The Gaithersburg lab is available on a fee basis for testing (estimated cost of \$5,000 per day).



F. TECHNICAL COMPLIANCE

3.1 PROPOSAL REQUIREMENTS

Submitted by:	Dawn Connet
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Signed:	
Print Name:	Dawn Connet
Title:	Senior Client Representative
Date:	12/18/2000

A. Process model

REQUIREMENT	INCLUDED	LOCATION
Process model	Y	3.1.A – Page 8

B. General qualifications and experience of the contractor firm:

REQUIREMENT	INCLUDED	LOCATION
Corporate and Sub-Contractor information	Y	3.1.B.1 – Page 11
Methodology, tools, standards and procedures	Y	3.1.B.2 – Page 12
Successfully designed, implemented and administered	Y	3.1.B.3 – Page 16
Project Principals	Y	3.1.B.4 – Page 18
Project Principals identified	Y	3.1.B.4.a – Page 18
Project Managers/Leaders/Team identified	Y	3.1.B.4.b – Page 18
Project Team shall not be substituted	Y	3.1.B.4.c – Page 18
Staff possesses cumulative experience	Y	3.1.B.4.d – Page 18

C. Work Plan:

REQUIREMENT	INCLUDED	LOCATION
Detailed Work Plan tasks, milestones, responsibilities, etc.	Y	3.1.C.1 – Page 19
Phase 1 ITD	Y	3.1.C.1.a - Page 19
Inside delivery and installation of 1 TB of mainframes storage NLT 2/12/01	Y	3.1.C.1.a.1 – Page 19
Storage consolidation	Y	3.1.B.2 – Page 12
Formal document of design available, options, recommendations NLT 3/12/01	Y	3.1.B.2 – Page 12



F. TECHNICAL COMPLIANCE

REQUIREMENT	INCLUDED	LOCATION
ITD Storage Consolidation NLT 3/12/01	Y	3.1.B.2 – Page 12
Implement Proof of Concept (Phase 1) of specified servers NLT 6/01/01	Y	3.1.B.2 – Page 12
Project schedule for implementation of remaining ITD servers NLT 6/1/01	Y	3.1.B.2 – Page 12
Implement SAN and consolidate storage for remaining servers per accepted schedule	Y	3.1.B.2 – Page 12
Phase 2 Capitol Complex	Y	3.1.B.2 – Page 12
Formal document of design, available options and recommendations NLT 6/01/01	Y	3.1.B.2 – Page 12
Project schedule to continue implementation of SAN and consolidation for Capitol Complex NLT 6/01/01	Y	3.1.B.2 – Page 12
Implement Proof of Concept (Phase 2) of specified sites	Y	3.1.B.2 – Page 12
Implement SAN and consolidate storage for remaining servers per accepted schedule	Y	3.1.B.2 – Page 12
Phase 3 Enterprise and Remote	Y	3.1.B.2 – Page 12
Formal document of design available, options, recommendations	Y	3.1.B.2 – Page 12
Project schedule for implementation of Enterprise and Remote servers	Y	3.1.B.2 – Page 12
Implement Proof of Concept (Phase 3) major data centers	Y	3.1.B.2 – Page 12
Implement SAN and consolidate storage for remaining servers per accepted schedule	Y	3.1.B.2 – Page 12
Complete Phase 3 implementation	Y	3.1.B.2 – Page 12
Phase 4 Integrate mainframe storage	Y	3.1.B.2 – Page 12
Formal document of design available, options, recommendations	Y	3.1.B.2 – Page 12
Project schedule for implementation of Enterprise and Remote servers	Y	3.1.B.2 – Page 12
Implement Proof of Concept (Phase 4) of major data centers	Y	3.1.B.2 – Page 12
Complete Phase 4 implementation	Y	3.1.B.2 – Page 12
Right to modify, reorder, cancel at any time	Y	3.1.B.2 – Page 12
Right to enter into additional contracts, or perform the work	Y	3.1.B.2 – Page 12
How each Phase of the project will be managed, prioritized and controlled	Y	3.1.B.2 – Page 12
Submits bi-weekly written Management/Status Reports	Y	3.1.B.2 – Page 12



F. TECHNICAL COMPLIANCE

3.2 MANDATORY DELIVERY, INSTALLATION, SUPPORT AND MAINTENANCE

REQUIREMENT	INCLUDED	LOCATION
Vendor installs and certifies system	Y	3.2.A – Page 23
Vendor provides all items	Y	3.2.B – Page 23
New, unused, currently manufactured and available from manufacturer	Y	3.2.C – Page 23
Vendor warrants all items for 1 – 3 years	Y	3.2.D – Page 24
Y2K compliant	Y	3.2.E – Page 24
Proposal include a description of the solution	Y	3.2.F – Page 24
Proposal includes a warranty and maintenance plan	Y	3.2.G – Page 28
Contact numbers, procedures, etc.	Y	3.2.G.1 – Page 28
Detailed listing of support services, policies, procedures to be provided, guaranteed service levels	Y	3.2.G.2 – Page 28
Maintenance includes PM	Y	3.2.G.3 – Page 30
Software maintenance installation of patches, enhancements, upgrades, optimization, reconfiguration	Y	3.2.G.4 – Page 30
Maintenance and support within one hour of receiving the request	Y	3.2.G.5 – Page 30
Contact and escalation procedures	Y	3.2.G.6 – Page 31
24 X 7 maintenance and support with single point of contact	Y	3.2.G.7 – Page 31
Location of hardware/software service, support and spare parts	Y	3.2.G.8 – Page 32



F. TECHNICAL COMPLIANCE

3.3 MAINFRAME STORAGE REQUIREMENTS

3.3 MAINFRAME STORAGE REQUIREMENTS

REQUIREMENT	INCLUDED	LOCATION
Has the capability to be upgraded to native Fibre Channel (FICON)	Y	3.3 - Page 33
Supports attachment to IBM 9672 R55	Y	3.3.A – Page 33
Minimum of 1 TB of usable capacity, expandable to 5 TB	Y	3.3.B – Page 33
Offers RAID-Protected storage (RAID 1 and 5), includes option of spare disk assemblies and dynamically replace failed drives	Y	3.3.C – Page 34
Minimum of 8 ESCON expandable to 16	Y	3.3.D – Page 34
Cache to ensure 10 msec response	Y	3.3.E – Page 34
Redundancy	Y	3.3.F - Page 35
N+1 power	Y	3.3.F.1 - Page 35
N+1 cooling	Y	3.3.F.2 – Page 35
Redundant channel paths	Y	3.3.F.3 – Page 35
Redundant device paths	Y	3.3.F.4 – Page 35
Mirrored write cache	Y	3.3.F.5 – Page 35
Concurrent maintenance	Y	3.3.G – Page 36
Remote maintenance	Y	3.3.H – Page 36
3 year minimum warranty	Y	3.3.I – Page 36
Upgradeable to support FICON	Y	3.3.J – Page 37
Includes point-in-time copy	Y	3.3.K – Page 37
Dynamic configuration, pre-configured, ... includes capability of dynamically changing its configuration under the control of the system administrator	Y	3.3.L – Page 37
Supports, at a minimum, 1024 logical volumes	Y	3.3.M – Page 37



F. TECHNICAL COMPLIANCE

3.4 MANDATORY REQUIREMENTS – SAN STORAGE CONSOLIDATION

REQUIREMENT	INCLUDED	LOCATION
Server types and Operating Systems	Y	3.4.A – Page 39
Compaq, Netfinity, NCR, Gateway Servers running NT/2000, Netware plus UNIX from IBM, Compaq/Digital and NCR	Y	3.4.A.1 – Page 39
Supports Intel-based servers and Windows/Netware operating systems and UNIX servers and operating systems	Y	3.4.A.2 – Page 39
Must support major Intel-based servers	Y	3.4.A.3 – Page 39
Provider must inventory and resolve differences	Y	3.4.A.4 – Page 40
Server consolidation must be transparent to storage consolidation	Y	3.4.A.5 – Page 40
The initial Storage Area Network design and storage consolidation must be for approximately (50) fifty servers within ITD (Phase 1) and must have the capability of being expanded to support the Enterprise (through Phase 4).	Y	3.4.B – Page 40
Storage network based on <i>open standard</i> Fibre Channel	Y	3.4.C – Page 43
Supports attachment of any fabric-capable storage to the storage network	Y	3.4.C.1 – Page 43
Supports attachment of any Intel-based and UNIX server capable of fabric attachment	Y	3.4.C.2 – Page 43
Must support standards	Y	3.4.C.3 – Page 44
Interoperability of fibre channel components have been tested at the vendor's or 3rd party interoperability lab	Y	3.4.C.4 - Page 44
Storage Network Ports - Initial storage network requires 120 fibre channel ports.	Y	3.4.D.1 – Page 44
Provides switch and hub components to meet the port count and performance req'mts	Y	3.4.D.2 – Page 44
Capability of expanding to 3X the number of ports	Y	3.4.D.3 – Page 45
Has SAN-to-SAN and WAN-to-WAN connectivity	Y	3.4.D.4 – Page 45
Capability of adding/removing fibre channel components without loss of redundancy or performance	Y	3.4.D.5 – Page 45
Storage Network Redundancy	Y	3.4.E – Page 45
Provides full redundancy so no single path or fibre channel component failure can prevent access to the storage pool.	Y	3.4.E.1 – Page 45
Configured with sufficient paths to maintain performance in the case of path or switch failure	Y	3.4.E.2 – Page 46
Each server on the network configured with at least 2 Fibre Channel paths	Y	3.4.E.3 – Page 46
Storage Network Guaranteed Bandwidth. Video applications have guaranteed bandwidth.	Y	3.4.F – Page 46
Storage Network Distance Req'mts. Initial consolidation is 10kilometers. Has the capability for expanding and attaching to other SANs located across the State (Enterprise). Provides SAN-to-SAN distances up to 100 kilometers and SAN-WAN-SAN distances greater than 100 kilometers	Y	3.4.G – Page 47
Fibre Channel Components. Supplies all components with	Y	3.4.H – Page 47



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REQUIREMENT	INCLUDED	LOCATION
a standard cost structure for the term of the contract.		
Storage Capacity Requirements.	Y	3.4.I – Page 48
Initial capacity configured for 3 TBs of usable disk storage	Y	3.4.I.1 – Page 48
Capability of the storage pool to expand to 20 TBs	Y	3.4.I.2 – Page 48
Storage Subsystem Requirements.	Y	3.4.J – Page 49
RAID protected storage. RAID-5 and RAID-1 running concurrently with option of active spare disk drives	Y	3.4.J.1 – Page 49
Native Fibre Channel host interface support with support of Fibre Channel fabric attachments, Class-2 service.	Y	3.4.J.2 – Page 49
Redundancy	Y	3.4.J.3 – Page 49
N+1 power	Y	3.4.J.3.a – Page 49
N+1 cooling	Y	3.4.J.3.b – Page 49
Dual-Active controllers with failover	Y	3.4.J.3.c – Page 49
Mirrored write cache	Y	3.4.J.3.d – Page 50
Redundant host interfaces	Y	3.4.J.3.e – Page 50
Dynamic configuration and ability to changing configuration	Y	3.4.J.4 – Page 50
Concurrent maintenance including dynamic replacement of major component groups, capacity upgrades and microcode	Y	3.4.J.5 – Page 50
Supports variable LUN sizes up to 500GB	Y	3.4.J.6 – Page 51
Remote maintenance	Y	3.4.J.7 – Page 51
Warranted for 3 years	Y	3.4.J.8 – Page 51



F. TECHNICAL COMPLIANCE

3.5 MANDATORY REQUIREMENTS – STORAGE NETWORK (SAN) MANAGEMENT

REQUIREMENT	INCLUDED	LOCATION
Includes a SAN management as described	Y	3.5.A.1 – Page 52
SAN management is redundant	Y	3.5.A.2 – Page 52
If appliance the appliance must be clustered	Y	3.5.A.2.a – Page 52
If running on an attached server, the server must have failover capabilities	Y	3.5.A.2.b – Page 53
Provides a <i>common discovery element</i> for fabric monitoring	Y	3.5.A.3 – Page 53
Common discovery agent performs <i>in-band</i> and <i>out-of-band</i> monitoring and management	Y	3.5.A.3.a – Page 53
Supports <i>SNMP MIBs</i> via out-of-band connection and the <i>Fibre Channel management MIB</i> via in-band paths	Y	3.5.A.3.b – Page 53
Provides topology mapping	Y	3.5.A.4 – Page 53
Provides Event Monitoring	Y	3.5.A.5 – Page 54
Has drill down capability	Y	3.5.A.5.a – Page 54
Provides remote capabilities	Y	3.5.A.5.b – Page 54



F. TECHNICAL COMPLIANCE

3.6 OTHER STORAGE NETWORKS FEATURES

REQUIREMENT	INCLUDED	LOCATION
Provides a LAN-free Backup feature	Y	3.6.A – Page 55
Provides remote copy of LUNs and files	Y	3.6.B – Page 55
Provides a point-in-time copy solution	Y	3.6.C – Page 55
Provides tape resource sharing on the SAN	Y	3.6.D – Page 56



F. TECHNICAL COMPLIANCE

3.7 EVALUATED FEATURES, CONSIDERATIONS AND ITEMS

FEATURES/CONSIDERATIONS	AVAILABLE/AWARDED	LOCATION
Mainframe storage		3.7.A – Page 57
Availability of PPRC	50	3.7.A.1 – Page 57
Supports storage partitioning with open system hosts including native Fibre Channel attachment	50	3.7.A.2 – Page 57
Ability to support additional logical volumes	25	3.7.A.3 – Page 57
SAN		3.7.B – Page 58
Provides server free data movement	50	3.7.B.1 – Page 58
Heterogeneous File Sharing	50	3.7.B.2 – Page 58
Policy –Based File Lifecycle Management	50	3.7.B.3 – Page 62
Policy-Based Data Placement	50	3.7.B.4 – Page 62
NAS Attachment	25	3.7.B.5 – Page 62
Automatic Disk Allocation	50	3.7.B.6 – Page 62
Automated Capacity Analysis	50	3.7.B.7 – Page 63
Automated Performance Analysis	50	3.7.B.8 – Page 63
Capacity Usage Charge-Back	50	3.7.B.9 – Page 63
Attachment of Current Storage Subsystems	25	3.7.B.10 – Page 64

ITEMS - PROPOSAL SECTION	AVAILABLE/AWARDED	LOCATION
Process Model	100	3.1.A – Page 8
Qualifications	125	3.1.B – Page 11
Work Plan	125	3.1.C – Page 19
Delivery, Installation, Support, Maint.	125	3.2 – Page 23



G. COST PROPOSAL

Submitted by:	Dawn Connet
Firm Name:	International Business Machines (IBM)
Address:	400 Locust St., Suite 400
City, State, Zip	Des Moines, IA 50309
Telephone:	515-28-4356
Fax:	515-283-2913
E-Mail Address:	daconn@us.ibm.com
Signed:	
Print Name:	Dawn Connet
Title:	Senior Client Representative
Date:	12/18/2000

CP1



G. COST PROPOSAL

The following cost structure (cost plus, discount from list, etc.) for goods and services shall be firm for the term of this contract and all extensions to the contract:

For the mainframe storage components

2105 Enterprise Storage Server	30%
3494 IBM Magstar Tape Library	25%
3590 IBM Magstar Tape Drive	25%

For SAN hardware components

2105-F20 IBM Enterprise Storage Server	30%
2106 IBM Modular Storage Server	25%
2032-001 McData ED-5000	30%
2032-C36 McData FC-512 Cabinet	30%
2042-001 INRANGE FC/9000 Fibre Channel Director	25%
2042-C40 INRANGE FC/9000 40U Cabinet	25%
2108-G07 SAN Network Data Gateway	25%
2108-R03 SAN Data Gateway Router	25%
2109-S08 SAN Fibre Channel Switch 8 Port	25%
2109-S16 SAN Fibre Channel Switch 16 Port	25%
2101 Seascope Solutions Rack	25%
3580 LTO Tape Drive	25%
3581 LTO Tape Autoloader	25%
3583 LTO Tape Library	25%
3584 LTO Tape Library	25%
7208 8MM Tape	25%
7337 DLT Tape	25%
3995 IBM Optical	25%
2103-H07 Fibre Channel Hub	25%
35601RU FAST EXP500	3% off Web Price
00N6881 FAST Host Adapter	3% off Web Price
00N6882 FAST 500 Mini Hub	3% off Web Price
01K7296 FC Failsafe RAID Controller	3% off Web Price
19K1121 FAST T200 Raid Controller	3% off Web Price
35261RU FC RAID Controller Unit	3% off Web Price
35341RU SAN FC Managed Hub	3% off Web Price
35421RU FAST 200 Storage Server	3% off Web Price
35521RU FAST 500 Storage Server	3% off Web Price
03K9307 FC Long-Wave GBIC	3% off Web Price
03K9308 FC Short Wave GBIC	3% off Web Price
03K9310 Netfinity 2M Ultra 2 SCSI Cable	3% off Web Price
03K9311 Netfinity 4.2M Ultra 2 SCSI Cable	3% off Web Price
36L9973 Netfinity Short Wave 1M FC Cable	3% off Web Price
03K9306 Netfinity Short Wave 5M FC Cable	3% off Web Price



G. COST PROPOSAL

Netfinity	9%
McData	
ES-1000 SAN Switch	20%
ES-3016 SAN Switch	20%
LP8000 Emulex Fibre HBA	20%
QLA2200F Qlogic Fibre HBA	20%
6227 IBM RS/6000 Fibre HBA	27%
Brocade	
Silkworm 6400 SAN Switch	10%
Finisar	
OptiLinx-2000 Optical Link Extender	10%
Crossroads	
conXsan 7100 Extended Router	10%
CNT	
UltraNet Open Systems Gateway	10%

For SAN software components

5698-Tivoli Software	10%
5648-IBM StorWatch software	25%
VERITAS Cluster Server	18%
VERITAS NetBackup Sgle Client Lic-AIX. And Linux	18%
VERITAS NetBackup Sgle Client Lic-NT.	18%
VERITAS NetBackup Sgle Client Lic-NetWare	18%
VERITAS NetBackup SAN Media Server Lic	18%
VERITAS NetBackup SAN Master Serv Lic NT	18%
VERITAS Library Tape Support for NBU	18%
VERITAS NetBackup Advanced Reporter	18%
VERITAS SANPoint Control, Solaris,Base	18%
VERITAS SANPoint Control, Solaris,100	18%

For support services

PDAS Premier Assist Support 7x24	0%
DAS Direct Assist Support 5x12	0%

For maintenance

Training

NetBackup Enterprise Training	0%
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G. COST PROPOSAL

Cluster Server Standard Training	0%
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Services

Cluster Server Standard Installation	0%
NetBackup Standard Installation	0%
SANPoint Assessment Service	0%
NetBackup ProLaunch Shared Option	0%
SANPoint ProLaunch	0%

Formal statements of work include agreed upon services and costs for services.

Other (See note below)

Fiber Cabling

Note: Identify all costs associated with the State's installation and operation of a Storage Area Network. This includes, but is not limited to, charges for changes/upgrades of microcode, fees for transferring software or microcode to different (new, future, etc.) hardware versions or platforms, and/or charges to configure or reconfigure. Only cost(s) identified in the successful solution providers proposal are billable.

Submitted by: _____

CP2



G. COST PROPOSAL

PHASE 1

One (1) terabyte of mainframe storage

Must include inside delivery, installation, training, operational, fully functional and accepted by Information Technology Department.

Hardware Costs (List all items separately) (add additional lines as necessary) ESS #1 2105-F20 ENTERPRISE STORAGE SERVER 1 1802 S/390 PAV UP TO 2 TB 1 2123 DISK EIGHT PACK 36.4 GB 6 2715 REMOTE SUPPORT FACILITY 1 3011 ESCON HOST ADAPTER 4 4002 8 GB CACHE 1 9301 MODEM COUNTRY GROUP M01 1 9401 CONVENIENCE CORD C01 1 9647 1,260 GB CAPACITY 1 9854 THREE PHASE 50/60 HZ 60 AMP 1 9870 NOMINAL AC VOLTAGE 200V-240V 1 *Optional Components (cost not in total) *1822 PPRC UP TO 2 TB 1 Net Cost \$49,044* *1832 FLASHCOPY UP TO 2 TB 1 Net Cost \$32,676*	Net Cost \$278,736
Software Costs (List all items separately) (add additional lines as necessary)	\$ 0 - No additional software cost.
Training Costs (List all items separately) (add additional lines as necessary) Enterprise Storage Server Implementation [SS40A] 3 days Intermediate Hands-on labs \$1,795	\$1,795
Installation/Integration/Roll-Out Cost (List all items separately) (add additional lines as necessary)	\$ 0 - No additional cost
Maintenance Costs (following warranty) (List all items separately) (add additional lines as necessary) Three year warranty on 2105 \$1200 per month after warranty.	\$0
Services Phase 1 - mainframe shark configuration	\$14,700
Other Costs (List all items separately)	



G. COST PROPOSAL

(add additional lines as necessary)	
TOTAL MAINFRAME STORAGE COST	\$295,231

Note: Identify all costs associated with the State's installation and operation of one (1) terabyte of mainframe storage. This includes, but is not limited to, charges for changes/upgrades of microcode, fees for transferring software or microcode to different (new, future, etc.) hardware versions or platforms, and/or charges to configure or reconfigure. Only cost(s) identified in the successful solution providers proposal are billable.

Submitted by: _____

CP3



G. COST PROPOSAL

PHASE 1

ITD Proof of Concept

Must include inside delivery, installation, training, operational, fully functional and accepted by Information Technology Department.

Hardware Costs (List all items separately) (add additional lines as necessary)		
ESS #2		
2105-F20 ENTERPRISE STORAGE SERVER	1	Net cost \$233,902
2123 DISK EIGHT PACK 36.4 GB	4	
2716 REMOTE SUPPORT FACILITY ATTACH	1	
3022 FIBRE CHANNEL SHORT WV.ADAPTER	4	
4002 8 GB CACHE	1	
9401 CONVENIENCE CORD C01	1	
9646 840 GB CAPACITY	1	
9854 THREE PHASE 50/60 HZ 60 AMP	1	
9870 NOMINAL AC VOLTAGE 200V-240V	1	
2032 McData ED-5000 w/EFC software, 32 fibre ports	1	Net cost \$128,975
OR *IBM 2109 fibre switches, 16 port,	2	OR Net cost \$61,440
Emulex LP8000 fibre HBAs	14	
and RS/6K FC 6227	2	Net cost \$29,900
IBM Netfinity 7100 700/2MB Pentium III	1	Net Cost \$74,662.42
IBM Netfinity 5100 Pentium III 733MHz	3	Net Cost \$38,842.44
Software Costs (List all items separately) (add additional lines as necessary)		
5648-SWV StorWatch Expert software	1	Net cost \$13,191
Tivoli Storage Network Manager (TSNM)	1	\$54,560
SANergy software	1	\$32,240
SL-CSB1-1500-2 VERITAS Cluster Server	2	\$16,800
PDAS Premier Assist Support 7x24	6	\$14,076
SL-NDCL-0000-2 NetBackup Single Client Solaris	2	\$1,120
PDAS Premier Assist Support 7x24	6	\$734
SL-NDSE-0012-2 NetBackup SAN Master Lic	1	\$3,850
PDAS Premier Assist Support 7x24	3	\$3,225.75
SL-NDCL-0001-2 Netbackup Single Client Lic NT	6	\$3,360
PDAS Premier Assist Support 7x24	18	\$2,203.20
SL-NDCL-0000-2 NetBackup Single Client Aix/Linux	2	\$1,120
PDAS Premier Assist Support 7x24	6	\$734.40
SL-NDTL-0000-0 Library Based Tape Support	2	\$4,200



G. COST PROPOSAL

PDAS Premier Assist Support 7x24	6	\$3,519	
SL-NDSS-0000 Shared Storage Option	2	\$2,800	
PDAS Premier Assist Support 7x24	6	\$3,519	
Training Costs (List all items separately) (add additional lines as necessary)			
Enterprise Storage Server Implementation [SS40A] 3 days Intermediate Hands-on labs		\$1,795	
McData Fibre Channel Training		\$495	
McData Implementation		\$1,395	
TC-CS-KAN Cluster Server Training (plus expenses)	1	\$1,950	
TC-NBU-ENT-MV2 NetBackup Enterprise Trng	1	\$1,950	
900-001024 One Media Documentation Kit	1	\$70	
900-001134 Media/Doc Kit NBU Master License	1	\$140	
900-000845 One Media/Documentation Kit	1	\$32	
Installation/Integration/Roll-Out Cost (List all items separately) (add additional lines as necessary)			
		\$0	
CS-NBS1-9900-S NetBackup Standard Install (plus expenses)	1	\$9,600	
CS-NSSO-9900 NetBackup ProLaunch Shared Storage Option (plus expenses)	1	\$10,000	
CS-VCS1-9900 Cluster Server Standard Install	1	\$9,600	
Maintenance Costs (following warranty) (List all items separately) (add additional lines as necessary)			
2105 - 3 yr. 24x7 warranty *\$1057/month after warranty		\$0	
2032 - 1 yr. 8x5 warranty Upgrade 3 yr. 24x7		\$37,000	
2109 - 1 yr. 24x7 warranty Upgrade 3 yr. 24x7			OR \$4,215
Emulex LP8000 fibre HBAs 3yr 8x5 warranty (We recommend the purchase of two additional spare cards in lieu of the 7x24 upgrade)		\$3,500	
Netfinity 7100 – 1 yr 24x7 warranty Upgrade 3 yr 24x7 2-hr		\$2,995	
Netfinity 5100 24x7warranty Upgrade 3 yr 24x7 2-hr		\$2,250	
TSNM – 1 yr 24x7 warranty support Upgrade 3 yr 8x5 support (15% of base price)		\$16,368	



G. COST PROPOSAL

Upgrade 3 yr 24x7 support (20% of base price)*	
SANergy – 1 yr 24x7 warranty support	
Upgrade 3 yr 8x5 support (15% of base price)	\$9,672
Upgrade 3 yr 24x7 support (20% of base price)	
Services	
SAN Design	\$58,200
open proof of concept shark box configuration	\$14,700
switch config 1 mcdata plus 8 servers	\$ 7,500
TSNM Implementation	\$35,000 estimated
(Pricing has been provided as a reference guide only and is NOT to be used a promise of service delivery. Tivoli Storage Network Manager is a new product and further analysis will need to completed before a promise of completion can be assessed.)	
Other Costs	
(List all items separately)	
(add additional lines as necessary)	
Fibre cabling @ .90/foot plus \$34 per fibre assembly (includes connectors)	
50' Cables and Assemblies 24	\$1,964
TOTAL PROOF OF CONCEPT COST	\$893,710 (McData 2032) \$793,390 (IBM 2109)

Note: Identify all costs associated with the State's installation and operation of a Storage Area Network. This includes, but is not limited to, charges for changes/upgrades of microcode, fees for transferring software or microcode to different (new, future, etc.) hardware versions or platforms, and/or charges to configure or reconfigure. Only cost(s) identified in the successful solution providers proposal are billable.

IBM has included a fixed price for the design services of the SAN. We have also provided expected costs for two options (one Brocade based and one McData based) for the Proof of Concept. We have also included the estimated configurations for the remaining servers implementation. While we anticipate that the configuration and quantities included in this proposal are valid for the Proof of Concept and the Remaining Servers implementation, we do not believe it is the State of Iowa's best interest to fix the price for the configurations until the design effort has been completed. IBM has proposed a fixed discount percentage on all hardware, software and fixed pricing for services that will be used to finalize the costs associated with the implementation of the Proof of Concept and the Remaining Servers implementation. If the State required the vendor to firmly fix the costs for the configuration of the SAN prior to finalizing the SAN design the configuration could be more than necessary. Additionally we do not know how many of the desirable items may be included in the Proof of Concept. IBM will work with the State of ensure you receive the best value from your investment during each phase of implementation.

Submitted by: _____

CP4



G. COST PROPOSAL

PHASE 1

Remaining ITD servers (Attachment 3B, disregard changes since this mailing)
Must include inside delivery, installation, training, operational, fully functional and accepted by Information Technology Department.

Hardware Costs (List all items separately) (add additional lines as necessary)		
Upgrade ESS #2		Net Cost \$296,588
Upgrade 9646 to 9643 3360GB		
2123 DISK EIGHT PACK 36.4 GB	12	
3022 FIBRE CHANNEL SHORT WV.ADAPTER	4	
9643 3,360 GB CAPACITY	1	
ESS(Optional)*		
1823 PPRC UP TO 4 TB	1	
Net Cost \$73,200*		
1833 FLASHCOPY UP TO 4 TB	1	
Net Cost\$49,044*		
2032 McData ED-5000, 32 ports,	3	Net Cost \$294,975
OR IBM 2109 fibre switches, 16 port ,	10	OR NetCost \$307,200
Emulex LP8000 fibre HBAs	84	Net Cost \$161,905
RS/6K FC 6227	6	
Software Costs (List all items separately) (add additional lines as necessary)		
Tivoli Storage Network Manager (TSNM)		\$163,680
SANergy software		\$135,780
SL-NDSE-0012-2 NetBackup SAN Master Lic	1	\$3,850
PDAS Premier Assist Support 7x24	3	\$3,225.75
SL-NDSE-0013-2 NetBackup SAN Media Serv Lic	10	\$19,250
PDAS Premier Assist Support 7x24	30	\$14,662.50
SL-NDCL-0002-2 NetBackup Single Client Netware	5	\$2,800
PDAS Premier Assist Support 7x24	15	\$1,836
SL-NDCL-0001-2 Netbackup Single Client Lic NT	37	\$20,720
PDAS Premier Assist Support 7x24	185	\$22,644
SL-NDCL-0000-2 NetBackup Single Client Aix/Linux	3	\$1,680
PDAS Premier Assist Support 7x24	8	\$1,101.60
SL-NDTL-0000-0 Library Based Tape Support	10	\$21,000
PDAS Premier Assist Support 7x24	30	\$17,595
SL-NDSS-0000 Shared Storage Option	10	\$14,000
PDAS Premier Assist Support 7x24	30	\$17,595
SL-NDAR-0000 NetBackup Advanced Reporter	1	\$10,500
PDAS Premier Assist Support 7x24	3	\$8,797.50
SL-SCSO-0000 SANPoint Control, Solaris, Base	1	\$3,497
SL-SCSO-0002 SANPoint Control, Solaris, 100	1	\$16,797



G. COST PROPOSAL

DAS Direct Assist Support 5X12	1	\$764.15
CS-NBV1-9900 Netbackup – Vault Ext. 2 (See services)		
PDAS Premier Assist Support 7x24	3	\$10,200
Training Costs (List all items separately) (add additional lines as necessary)		
TC-NBU-ENT-MV2 NetBackup Enterprise Trng	1	\$1,950
900-00845 One Media Documentation Kit SSO	1	\$35
900-001134 Media/Doc Kit NBU Master License	1	\$140
900-0001086 Advanced Reporter/Documentation Kit	1	\$32
900-001155 Media /Documentation Kit NBU	1	\$69
Installation/Integration/Roll-Out Cost (List all items separately) (add additional lines as necessary)		
CS-NBS1-9900-S NetBackup Standard Install (plus expenses)	2	\$19,200
CS-NSSO-9900 NetBackup ProLaunch Shared Storage Option (plus expenses)	1	\$10,000
CS-SPAS-9900 SANPoint Assessment Service (Plus Expenses)	1	\$24,000
CS-SPCO-9900 SANPoint Prolaunch (Plus Expenses)	1	\$10,000
CS-NBV1-9900 Netbackup Vault Ext 2TLD Robots (Plus Expenses)	1	\$20,000
Maintenance Costs (following warranty) (List all items separately) (add additional lines as necessary)		
2105 - 3 yr. 24x7 warranty *\$980/month after warranty		\$0
2032(qty 3) 1 yr. 8x5 warranty Upgrade 3 yr. 24x7		\$88,500
2109(qty 10) 1 yr. 24x7 warranty Upgrade 3 yr. 24x7		OR \$21,077
Emulex LP8000 fibre HBAs 3yr 8x5 warranty (We recommend the purchase of two additional spare cards in lieu of the 7x24 upgrade)		\$3,500
Services		
Proposed Phase 2 and 3 Implementation - option 1		
open shark configuration (4 LUNs)		\$14,700
additional LUN planning and configuration (49)		\$12,520
switch configuration 12 brocade sw's plus 53 server		\$30,000
Proposed Phase 2 and 3 Implementation - option 2		
open shark configuration (4 LUNs)	\$14,700	



G. COST PROPOSAL

additional LUN planning and configuration (49) \$12,520 switch configuration of 4 mcdata plus 53 servers \$30,000 The above costs are estimates based on the two proposed designs. Phase 2 and Phase 3 will be accurately priced after completion of a customized SAN design (CP4). Phase 4 Implementation Sanergy Implementation (10 servers; 2 controllers) Each Additional Server: \$500 Each Additional MDC: \$3,000	 \$7,500 \$12,000
Other Costs (List all items separately) (add additional lines as necessary) Fibre cabling @ .90/foot plus \$34 per fibre assembly (includes connectors) 50' Cables and Assemblies 90	 \$7,380
TOTAL REMAINING ITD SERVERS COST	\$1,526,970 (McData 2032) OR \$1,471,772 (IBM 2109)

Note: Identify all costs associated with the State's installation and operation of a Storage Area Network. This includes, but is not limited to, charges for changes/upgrades of microcode, fees for transferring software or microcode to different (new, future, etc.) hardware versions or platforms, and/or charges to configure or reconfigure. Only cost(s) identified in the successful solution providers proposal are billable.

IBM has included a fixed price for the design services of the SAN. We have also provided expected costs for two options (one Brocade based and one McData based) for the Proof of Concept. We have also included the estimated configurations for the remaining servers implementation. While we anticipate that the configuration and quantities included in this proposal are valid for the Proof of Concept and the Remaining Servers implementation, we do not believe it is the State of Iowa's best interest to fix the price for the configurations until the design effort has been completed. IBM has proposed a fixed discount percentage on all hardware, software and fixed pricing for services that will be used to finalize the costs associated with the implementation of the Proof of Concept and the Remaining Servers implementation. If the State required the vendor to firmly fix the costs for the configuration of the SAN prior to finalizing the SAN design the configuration could be more than necessary. Additionally we do not know how many of the desirable items may be included in the Proof of Concept. IBM will work with the State of ensure you receive the best value from your investment during each phase of implementation

Submitted by: _____

CP5



G. COST PROPOSAL

Total Cost of Phase 1 mainframe storage	\$295,231
Total Cost of Phase 1 proof of concept	\$893,710 or \$793,390
Total Cost of Phase 1 Remaining Servers	\$1,526,970 or \$1,471,772
TOTAL PHASE 1 COSTS	\$2,715,911 or \$2,560,393

Note: Identify all costs associated with the State's installation and operation of one (1) terabyte of mainframe storage. This includes, but is not limited to, charges for changes/upgrades of microcode, fees for transferring software or microcode to different (new, future, etc.) hardware versions or platforms, and/or charges to configure or reconfigure. Only cost(s) identified in the successful solution provider's proposal are billable.

Submitted by: _____

CP6



G. COST PROPOSAL

SAN Components//Capabilities and Purpose

For each application provide a make and model number (#) and price(\$).
Add components and lines if necessary.

Note: Identify all costs associated with the State's installation and operation of a Storage Area Network. This includes, but is not limited to, charges for changes/upgrades of microcode, fees for transferring software or microcode to different (new, future, etc.) hardware versions or platforms, and/or charges to configure or reconfigure. Only cost(s) identified in the successful solution providers proposal are billable.

	Campus SAN (10 KM)		SAN to SAN 100 KM Distance		Statewide SAN SAN/WAN/SAN	
Fibre Channel Components	Make/Model		Make/Model		Make/Model	
FC Switches						
▪ Total Switches	Brocade or		Brocade or		Brocade or	
▪ Manufacturer	McData		McData		McData	
▪ Manufacturer	IBM 2109 or		IBM 2109 or		IBM 2109 or	
Model	ED-5000		ED-5000		ED-5000	
▪	16 or 32		16 or 32		16 or 32	
▪ Number Of						
Ports/Switch						
▪ Port Types (list)	F,FL,E,G or		F,FL,E,G or		F,FL,E,G or	
▪	F,G,E,FL (with		F,G,E,FL (with ES-		F,G,E,FL (with ES-	
▪	ES-1000)		1000)		1000)	
▪						
▪ FC Interconnect	Long/Short		Long/Short Wave		Long/Short Wave	
Other	Wave GBIC		GBIC		GBIC	
FC Hubs						
▪ Total Hubs						
▪ Manufacturer						
▪ Manufacturer						
Model						
▪ Number of						
Ports/Hub						
▪ FC Interconnect						
Other						



G. COST PROPOSAL

FC Host-Bus Adapters/Server <ul style="list-style-type: none"> Total Adapters/Server Server Type Manufacturer Manufacturer Model Other	Emulex LP800 Intel Emulex	Emulex LP800 Intel Emulex	Emulex LP800 Intel Emulex	
FC Bridges <ul style="list-style-type: none"> Total Number Manufacturer Manufacturer Model Other		Finisar Optilinx 2000 Fibre Channel Extender	Crossroads And CNT ConXsan 7100 Extended Router Ultramer Open Systems Gateway	
FC Cables and Connectors <ul style="list-style-type: none"> FC Cable Cable Type FC Connectors Connector Type Other	50 micron multimode SC	TBD	TBD	
SAN Manager and Software <ul style="list-style-type: none"> Software Components Hardware Components License Fees Maintenance Fees Other	Tivoli Storage Network Manager Intel 600 Mhz Server, 1GB	Tivoli Storage Network Manager Intel 600 Mhz Server, 1GB	Tivoli Storage Network Manager Intel 600 Mhz Server, 1GB	
SAN Storage	Make/Model	Make/Model	Make/Model	
Storage Subsystems <ul style="list-style-type: none"> Number of Subsystems Total Capacity Features License Fees Maintenance Fees Other	IBM 2105 F20 1 3360 GB usable 3022 – 8 fibre 4002 - 8GB cache 0 3 year warranty	TBD	TBD	



G. COST PROPOSAL

OTHER (describe) add lines if necessary	Make/Model		Make/Model		Make/Model	

Note: Identify all costs associated with the State's installation and operation of a Storage Area Network. This includes, but is not limited to, charges for changes/upgrades of microcode, fees for transferring software or microcode to different (new, future, etc.) hardware versions or platforms, and/or charges to configure or reconfigure. Only cost(s) identified in the successful solution providers proposal are billable.

Submitted by: _____

CP7



APPENDIX A



APPENDIX B



APPENDIX C



APPENDIX D

We recommend the following IBM class for implementing the IBM 2105 Enterprise Storage Server.

IBM class: SS40A, Enterprise Storage Server Implementation for the IBM 2105-F20 Enterprise Storage Server.

Duration: 3 Days
Delivery Method: Classroom
Skill Level: Intermediate
Audience Type: Public/Private
Language: English
Tuition: \$1795

Overview:

This course introduces you to the IBM 2105 Enterprise Storage Server (ESS) and its supporting software products, including the StorWatch ESS Specialist and the StorWatch ESS Expert. Receive an overview of the functions provided by each of the products, and participate in hands-on labs using the ESS Specialist to configure the ESS subsystem.

Who Should Take This Course:

Storage administrators, system programmers and support groups with responsibilities for storage subsystem in the open systems and mainframe environments.

What You Are Taught:

- ◆ Identify the components and features of the Enterprise Storage Server
- ◆ Identify the host attachments for the ESS
- ◆ Describe the logical configuration of the ESS
- ◆ Identify the attachment considerations of the ESS for open systems platforms
- ◆ Describe how to access logical volumes defined for the ESS
- ◆ Describe the copy services function of Concurrent Copy, FlashCopy, PPRC and XRC
- ◆ Describe the setup and functions of the ESS Expert

Topics Include:

- ◆ ESS Hardware Overview
- ◆ StorWatch ESS Specialist Overview
- ◆ StorWatch ESS Specialist
- ◆ ESS Specialist Labs - General functions
- ◆ Configuration Functions
- ◆ CKD Configurations or FB Configurations
- ◆ Configuration Flow



APPENDIX D

- ◆ Using ESS Configuration Worksheets
- ◆ Configuration Labs using ESS Specialist
- ◆ S/390 CKD Configurations
- ◆ Open Systems Configurations
- ◆ ESS Specialist Labs - S/390 and Open Systems configurations
- ◆ Open System Attachment Considerations
- ◆ S/390 Attachment Considerations
- ◆ ESS Performance and Tuning Guidelines
- ◆ ESS Copy Services
- ◆ Concurrent Copy/XRC/FlashCopy/PPRC
- ◆ FlashCopy/PPRC
- ◆ Logical Volume use
- ◆ StorWatch ESS Expert Performance and Reporting Labs
- ◆ Installation Overview
- ◆ Data Collections and Reporting
- ◆ Performance and Reporting Labs
- ◆ Q & A and Evals

We recommend the following IBM classes to provide adequate product knowledge and training for the SAN implementation.



APPENDIX D

IBM class: Storage Area Networks (SANs): An Introduction

Course Code: SS700

Duration: 1.5 Days

Delivery Method: Classroom

Skill Level: Basic

Audience Type: Public/Private

Language: English

Tuition: \$595

Overview:

Examine products and strategies associated with managing the explosive growth of business data across the enterprise in today's networking economy. Learn the basic concepts and terminology associated with SANs, and map the promise of SANs to the complications of managing islands of information among heterogeneous environments with disparate operating systems, data formats, user interfaces, and limited integration of products from assorted vendors. Learn how to enable your enterprise to take advantage of this relatively new approach to information management.

If you have completed or are enrolled in the International Technical Support Organization (ITSO) SAN Workshop: Introduction and Initial Planning, you will find a considerable amount of overlap in content. You should examine this description in detail to determine the benefit of this course to you.

Who Should Take This Course:

IT architects, system engineers, and other specialists who need a general introduction to the SAN environment.

What You Are Taught:

- ♦ Describe SAN facilitated value-add solutions including: disk or tape resource pooling, LAN-free backup, server-less backup, high availability clustering, and disaster tolerance
- ♦ Define SAN terminology including: fibre channel architecture, data transfer protocols, nodes, ports, fabric, switches, hubs, bridges, and gateways
- ♦ Investigate intelligent features associated with storage products that facilitate storage consolidation
- ♦ Identify resource access and sharing options provided by IBM SAN components
- ♦ Recognize the purpose of the StorWatch family of products, Tivoli Enterprise Management, and how they relate to the overall standard initiatives for SAN management
- ♦ Illustrate the usage of the IBM SAN Data Gateway, fibre channel hubs, and switches in establishing a SAN environment



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Topics Include:

- ♦ Evolution to SANs
- ♦ Enterprise Storage Infrastructure Challenges ==> SAN
- ♦ SAN Application Solutions
- ♦ Introduction to Fibre Channel
- ♦ Fibre Channel Architecture
- ♦ Fibre Channel Physical Model
- ♦ Storage Consolidation and Fabric Components
- ♦ Storage Consolidation
- ♦ Resource Access and Sharing
- ♦ Fabric Components
- ♦ SAN Management Overview
- ♦ Simple Network Management Protocol (SNMP)/Management Information Bases (MIBs)
- ♦ StorWatch/Tivoli Storage Manager
- ♦ SAN Pain-Relief Summary

Prerequisites: None.



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IBM class: Implementing SAN Solutions

Course Code: SS71A

Duration: 2.5 Days

Delivery Method: Classroom

Skill Level: Intermediate

Audience Type: Public

Language: English

Tuition: \$2495

Overview:

This intermediate-level, 2 ½-day, hands-on course provides the in-depth working knowledge and skills needed to implement Fibre Channel SAN solutions. This course starts with your knowledge of Fibre Channel SAN basics, adding technical discussions of protocols, SAN connectivity and security considerations, and specific SAN product training. Lecture and lab activities focus on how to plan, design, install, and configure Storage Area Networks (SANs) in NT and UNIX environments. The skills developed can also be applied to other environments. Lab activities include more than eight hours of hands-on configurations and demonstrations with a variety of Fibre Channel products and configurations.

Who Should Take This Course:

Professionals responsible for Consulting Services, Sales, and Management of SANs solutions will benefit from this course.

What You Are Taught:

- ◆ Determine the cabling and connectivity options for Storage Area Networks
- ◆ Specify SAN management and security considerations
- ◆ Define Fibre Channel Protocols and Frames
- ◆ Apply implementation considerations and techniques to successfully install Fibre Channel Arbitrated Loop and Fabric Switch solutions
- ◆ Connect and configure the Fibre Channel components in any specified topology given the system components (hubs, switches, servers, and disk storage)
- ◆ Apply concepts learned in lecture and lab to design a simple SAN

Topics Include:

- ◆ Fibre Channel Cabling and Connectivity
- ◆ SAN Security and Management
- ◆ Fibre Channel Arbitrated Loop Lab
- ◆ Fibre Channel Protocols



APPENDIX D

- ◆ SAN Product Training
- ◆ Fibre Channel Switch Lab
- ◆ Design Considerations
- ◆ Design Activity

Prerequisites: Attendance in Storage Area Networks (SANs): An Introduction (SS700) or equivalent course or experience. Fibre Channel Basics is a firm prerequisite. Familiarity of UNIX or NT Systems Administration is preferred, but the use of team lab work will compensate for some weakness in systems knowledge.



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McData Educational Services offers a full range of vendor-independent enterprise SAN training. A list of current offerings is listed below. McData Educational Services classes are also available onsite in Des Moines for \$ 4,500 per day (all expenses included). Onsite education is intended for audiences of 10 or more students.

McData Educational Services Course Summaries

SAN ESSENTIALS

- ♦ 1-hour live lecture briefing
- ♦ Offered from McData website
- ♦ No charge

FIBRE CHANNEL SAN BASICS

- ♦ 1-day lecture
- ♦ Comprehensive technical introduction
- ♦ \$ 495

IMPLEMENTING SAN SOLUTIONS

- ♦ 2.5 day lecture and lab
- ♦ Intermediate training for SAN engineers
- ♦ Labs: FC-AL, fabric, bridge, SAN management
- ♦ \$ 1,395

DESIGNING THE SAN INFRASTRUCTURE

- ♦ 2-day lecture
- ♦ Step-by-step work project activities
- ♦ \$1,595

FIBRE CHANNEL PROTOCOLS

- ♦ 3-day lecture
- ♦ Analysis activities
- ♦ \$ 1,295

USING ENTERPRISE CONNECTIVITY

- ♦ 3 hour lecture and lab
- ♦ Hands-on activities with McData console manager
- ♦ No charge: conducted at the customer site



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Additional class information available at the following websites:

<http://www.3.ibm.com/services/learning>

<http://www.mcdata.com/>



APPENDIX D

Managing Your SAN with Tivoli Workshops

TARGETED AUDIENCE: Tivoli/IBM Internal and Business Partners

DESCRIPTION: The promise of SAN's are now being realized as basic infrastructures are implemented. Now, customers face the challenge of managing complex, diverse environments where standards are only now emerging. Tivoli Storage Network Manager is the latest addition to Tivoli's SAN product line and provides monitoring and control in a heterogeneous SAN environment. It has the following functions:

- ◆ Network Management
 - Discovers and displays your SAN and disk topology using a NetView console
 - Monitors devices continuously to help with problem identification and resolution
 - Follows launching of vendor specific management applications
- ◆ Disk Management
 - Provides secure, device independent disk assignment (LUN Masking) across multiple operating systems
- ◆ File System Policy Management
 - Monitor critical file systems for a defined capacity threshold
 - Automatically assign more space and nondisruptively extend file systems when they exceed the threshold

This session will provide a comprehensive introduction to Tivoli Storage Network Manager, including detailed coverage of its capabilities, hints for deployment and supporting technologies. It will show you how to use Tivoli Storage Network Manager to keep control of your SAN, reduce administrative complexity and increase application availability. Other topics include tape library sharing and LAN-free backup with Tivoli Storage Manager and an update on Tivoli SANergy Filesystem.

AGENDA:

- ◆ Day 1 9:00 AM- 12:30 PM: TSNM Sales and Marketing overview
- ◆ Day 1 1:30 PM - 5:00 PM: TSNM Technical Workshop part 1
- ◆ Day 2 9:00 AM - 4:00 PM: TSNM Technical Workshop part 2

Proposed agenda for TSNM Technical Workshop:

- ◆ Introduction to SAN and SAN Management
- ◆ Introduction to Tivoli Storage Network, Network Manager and Building Blocks
- ◆ TSNM Network Management
- ◆ TSNM LUN Management
- ◆ TSNM Storage Automation
- ◆ TSNM Installation
- ◆ TSNM Troubleshooting and Operational Issues
- ◆ SAN Exploitation with Tivoli Storage Manager
- ◆ Tape Library Sharing
- ◆ LAN-free backup



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- ◆ Tivoli SANergy update

PRE-REQUISITE KNOWLEDGE:

Attendees need to have basic storage management, networking and SAN hardware/architecture skills.

SESSIONS:

For each location there are two sessions as follows:

1. Half day Sales/Marketing Overview
2. 1.5 day ITSO Technical workshop.

The Sales/Marketing overview on the first morning covers the marketing and positioning aspects of TSNM. The ITSO workshop (consisting of presentations) is aimed at a more technical audience who need to understand the product in depth. Attendees can go to either or both sessions as appropriate. The optional last part of the technical workshop (covering SANergy and Tivoli Storage Manager in a SAN environment) assumes knowledge of these products.

PRE-REGISTRATION IS REQUIRED:

To register scroll down to location you wish to attend and click on the Marketing Overview session link or ITSO Technical Workshop session link. This will take you to the registration form for that session. If you want to attend both sessions you must register for each session separately.

When you are asked for Payment Information use the following:

Payment Method

You must enter the following in the financial fields.

1. Choose "Corporate Check"
2. Check # -- Enter "0"
3. Check Amount -- Enter "\$0"



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DATES/LOCATIONS & REGISTRATION LINKS:

NOTE: Conference Facility Locations and Addresses will be announced December 18-- North America and January 5--EMEA, LA and AP.

San Francisco, CA -- January 17-18, 2001

Sales/Marketing Overview

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/52C4A412369AC76B862569AE006E22C9?OpenDocument>

ITSO Technical Workshop

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/69EE24A62420D7DB862569AB007290D8?OpenDocument>

Newark, NJ -- January 22-23, 2001

Sales/Marketing Overview

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/89877D9692D6625D862569AE006E89D8?OpenDocument>

ITSO Technical Workshop

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/1FDA94CC4F54B923862569AB00743AA0?OpenDocument>

Toronto, Canada -- January 24-25, 2001

Sales/Marketing Overview

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/A6EC24D52BA341AC862569AE006EDBDF?OpenDocument>

ITSO Technical Workshop

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/E8CEC2AD60A80D9A862569AB00757909?OpenDocument>



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Austin, TX -- February 12-13, 2001

Sales/Marketing Overview

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/9E1CB71A40583BE9862569AE006F906F?OpenDocument>

ITSO Technical Workshop

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/F4FFBD0C9D844EB1862569AB0076AB7C?OpenDocument>

Atlanta, GA -- February 14-15, 2001

Sales/Marketing Overview

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/BBE470B2D64A56A4862569AE006FAC9E?OpenDocument>

ITSO Technical Workshop

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/0E2B40FDA328EFE4862569AB0076C939?OpenDocument>

Chicago, IL -- March 5-6, 2001

Sales/Marketing Overview

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/B743A1D814043457862569AE0070BC44?OpenDocument>

ITSO Technical Workshop

<https://www.tivoli.com/SSL/trainmgr.nsf/24EC61BA0E6ACA0B8625659300648C70/BCE6FEBEC514E959862569AB0078268B?OpenDocument>

If you have any questions, or need additional information, you may contact Shari Rivera at 408 361-0516 or e-mail mailto:shari_rivera@tivoli.com



APPENDIX E - RESUMES

JEFFREY WORTNER

IBM Storage Services, Certified I/T Storage Specialist,

Jeff Wortner is a Certified I/T Specialist in the IBM National Storage Competency Center. His field of expertise in the Storage Management/Data Processing arena is a result of 20 years of experience in the Data Processing industry.

For the past two years Mr. Wortner has focused on Storage Area Networks (SAN). During this period he has been involved in most of the IBM early SAN training programs and had key responsibility in assessing and choosing the McData SAN training courses and SAN methodology which is being rolled out throughout the IBM field.

During this period, Mr. Wortner developed and delivered the first Enterprise SAN Assessment/Implementation offerings performed by IBM IGS, one of which resulted in IBM's first customer reference for SAN services. He is current responsibility is primarily developing, delivering, and training IBM field personnel to perform SAN Assess/Design/Implementation services.

Prior to working in SAN services, Mr. Wortner's job responsibilities included developing and performing Storage Assessments for large mainframe customers. During this time he worked closely with SSD developing the DFSMS Optimizer product, which is used to generate the mainframe Storage Assessments.

Prior to this he spent many years assisting customers in implementing Data Facility System Managed Storage (DFSMS). These responsibilities included consultation in the development and execution of project plans, installation and exploitation of storage software, delivery of educational presentations, and overall success in converting to DFSMS. He has been involved with large mainframe customers including banking, automotive, governmental, and hospital type agencies. In doing this he has not only kept up with the development of IBM's storage software, but has also acquired valuable knowledge of other manufacture's products, some of which include DMS, FDR/ABR, POOLDASD, ASM2, TOPSECRET, ACF2, STOPX37, among others.

Prior to joining IBM's National Storage Competency Center, Mr. Wortner's technical background was key in providing him with the skills necessary to gain his customers confidence in his consulting abilities. In his 20 years at IBM, Mr. Wortner has worked in the Operations, Networking and Storage Management arenas, with the latter being the most prevalent.

In the early part of his career, Jeff's Operations background provided him with a broad based knowledge of the Data Processing industry. From Operating Systems to Subsystems, Hardware to Software, JCL to Programming, Operations provided these skills. After 3 years of Operations, leaving as a Technical Shift Leader, Jeff entered the Storage Management field.

After leaving operations, Jeff's career has revolved exclusively around Storage Management. He spent 5 years working in the Storage Management department at IBM's



APPENDIX E - RESUMES

Sterling Forest NY installation. During this part of his career, Jeff acquired his expertise with storage products such as DFHSM, DFDSS, RACF, ICKDSF, and ICF CATALOGS. He also became skilled with support products such as TSO/ISPF, JCL, PLI, RMDS, MVS, JES2, JES3, etc. During these years, Jeff was a key player in several large projects. Some highlights include IBM's regionalization effort in which 5 separate data centers were moved/merged into Sterling Forest resulting in a quadruplex of 3090 600's with over 2000 volumes of shared DASD. Jeff's responsibilities in this project included the movement of the data, the merger of Catalogs, RACF, DFHSM, along with other storage related matters.



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Michael Riney

Certified I/T Consulting Specialist, Large System and Storage Practice, Storage Competency Center

Twenty-Five years experience with IBM with job responsibilities ranging from Program Support Representative to Consulting I/T Specialist experienced in advising and implementation of storage technology on the System 390 and open systems platforms. Experiences include SAN consulting, design, and implementation, migration of client's tape subsystem to the IBM 3494s and Virtual Tape Server technology, Development of IBM 3494 Migration Services, tape sizing and configuration studies for the VTS and native 3590 Magstar tape libraries, Storage Assessments to maximize client's storage investment, Tape Mount Management, DFHSM Implementations, DFHSM Performance Reviews, DFSMS Implementations, education, and storage services development.

Professional Experience

GE Capital tape analysis and project planning in support of tape migration from STK Silos to IBM Virtual Tape Server (VTS) and 3494 native Magstar libraries. The result will be the replacement of 62 Silos with IBM technology.

Storage lead on ATT I/T consulting engagement that resulted in recommendations totaling \$6 million per year for one sysplex.

VTS implementation lead at State Farm Insurance for a migration to 11 VTSs.

VTS and 3494 consulting for Goodyear's implementation that resulted in replacing 6 Silos.

Project and technical lead on many VTS and 3494 implementations.

DFHSM Implementation Reviews to analyze client's existing DFHSM environment with recommendations that have resulted in significant savings in tape and CPU resources.

DFHSM Implementations with recommendations to maximize HSM's capabilities resulting in a shorter maintenance window and increased batch window.

DFSMS implementations allowing the client to take advantage of the SMS platform quickly and with a minimum of human resources.

Tape Mount Management consulting to maximize the tape subsystem.

Storage Management Assessments to review a client's total storage environment with recommendation for improved utilization of their current investment.



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Education and Accomplishments

- ◆ University of Michigan - Dearborn
- ◆ Henry Ford Community College
- ◆ Performance Management I/O (PMIO) - Washington System Center
- ◆ I/O Performance
- ◆ DFHSM Implementation
- ◆ SSD Storage Institute
- ◆ MVS PSR Training
- ◆ VM PSR Training
- ◆ VSE PSR Training
- ◆ Speaker - Storage Symposium
- ◆ Speaker - Enterprise Technology Update
- ◆ Speaker - Success '98
- ◆ IBM Means Service Recipient



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Jerome "J" Lauth,

Sr. Consultant with McData

J has more than 10 years of experience providing services to the data and telecommunications industry. Before joining McData, he was a senior manager with an organization he helped expand from a local design/implementation company to a national solution provider corporation. He has accomplished a unique blend of "hands on" technical and managerial experiences through roles including technician, project manager, designer, branch manager and national accounts manager. J has provided solutions to virtually every industry type and has worked with a vast number of the large system integrator and OEM organizations. He has a great deal of expertise designing and implementing infrastructures for inside and outside projects ranging from large area campuses with multiple facilities to single facilities with multiple locations throughout the world.



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Doug Purintun

Storage Systems Engineer

Before joining MSI, Doug spent seven years with Nebraska Public Power District as a programmer and network support specialist. He was involved with Level III network troubleshooting on mainframes, RS/6000, Microsoft Windows NT, Novell systems, and Cisco routers. This varied background – plus completion of courses in Advanced System Administration for AIX V. 4 and RS/6000 SP Overview Planning and Installation – prepared him for his role at MSI, where he handles RS/6000 and AIX installation setup/configuration and troubleshoots AIX, networks and routers. In these capacities, he has worked with Pamida, Mutual of Omaha, ConAgra, Continental General Insurance, Sitel, Norwest, and Holiday Corporation. Doug has a Bachelor of Science degree in electronics engineering technology (DeVry Institute of Technology).

